August 7, 1961

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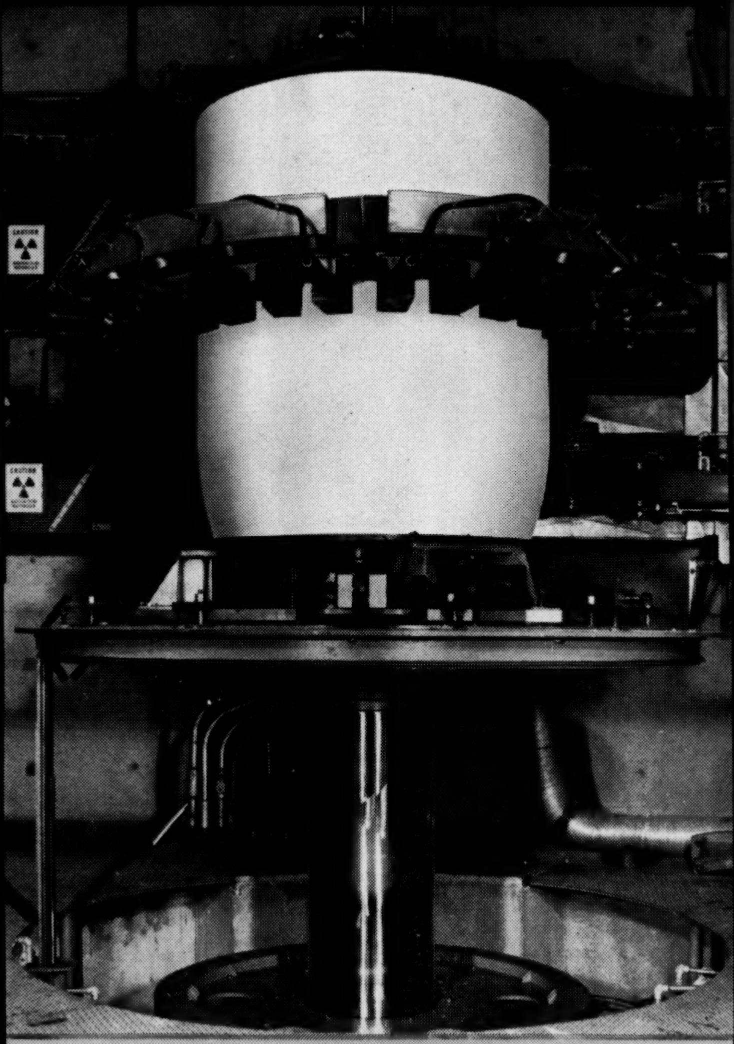

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AVIATION CALENDAR

Aug. 15-17—Cryogenic Engineering Conference, University of Michigan, Ann Arbor.

Aug. 16-18—International Hypersonics Conference, American Rocket Society, MIT, Cambridge, Mass.

Aug. 19-24—Institute of the Aerospace Sciences/Naval Aviation Meeting, San Diego, Calif. (classified).

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Aug. 23-25—Fourth Biennial Gas Dynamics Symposium, American Rocket Society, Northwestern Technological Institute, Evanston, Ill.

Aug. 24-26—Sixth Annual National Reunion, OX5 Club of America, Allis Hotel, Wichita, Kan.

Aug. 28-30—West Coast Conference of Applied Mechanics, University of Washington, Seattle, Wash.

Aug. 28-30—Air Force/Aerospace Corp.'s Symposium on Ballistic Missile and Aerospace Technology, University of Southern California, Los Angeles, Calif.

Aug. 28-Sept. 1—International Heat Transfer Conference, University of Colorado, Boulder, Colo.

Aug. 28-Sept. 1—Third International Symposium on Rockets and Astronautics, Japanese Rocket Society, Tokyo, Japan.

Aug. 30-Sept. 1—Second Annual Bionics Symposium, General Electric Advanced Electronics Center, Cornell University, Ithaca, N. Y.

Aug. 30-Sept. 1—Third Annual Semiconductor Conference, American Institute of

(*Continued on page 6*)

AVIATION WEEK and Space Technology

August 7, 1961

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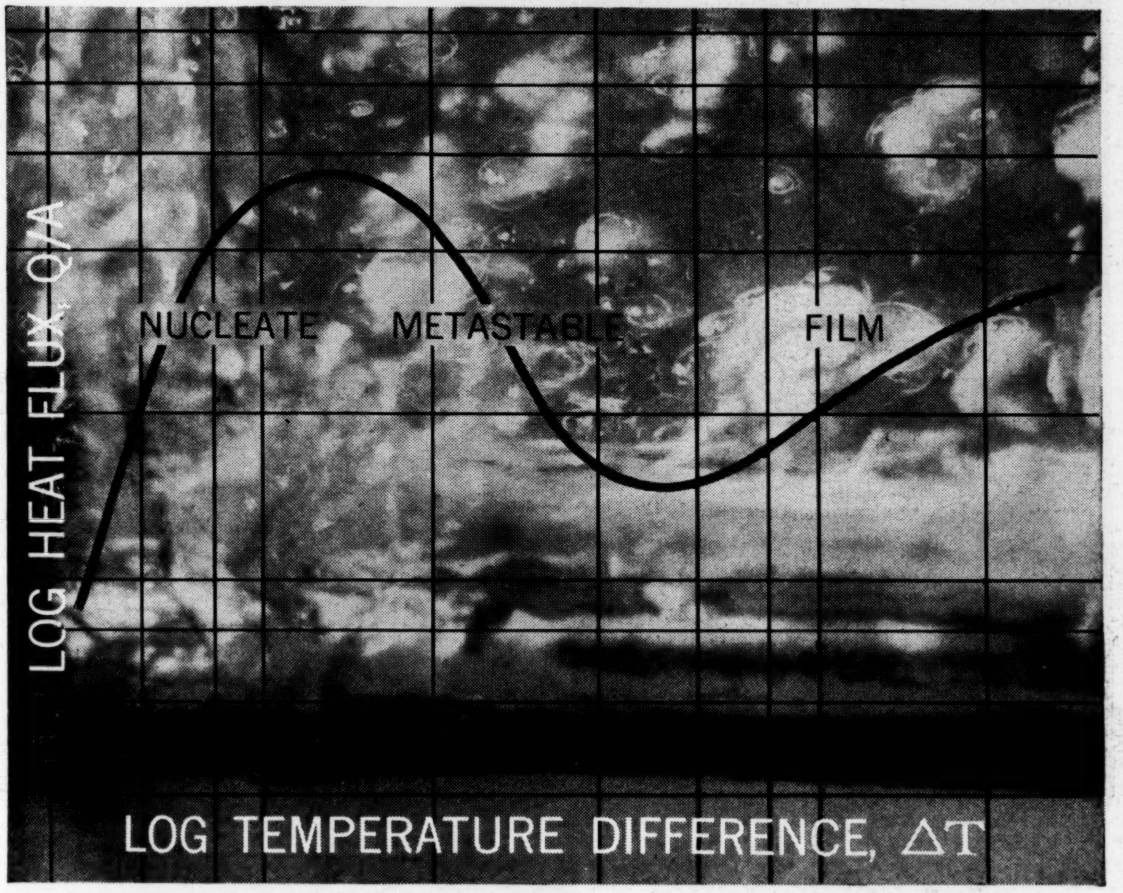

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AVIATION CALENDAR

(*Continued from page 5*)

Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, England. Wilbur Wright Memorial Lecture, Sept. 12.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 6-8—Joint Nuclear Instrumentation Symposium, North Carolina State College, Raleigh, N. C. Sponsors: American Institute of Electrical Engineers; Instrument Society of America; IRE.

Sept. 7-8—Fall Meeting, Western States Section/The Combustion Institute. University of California, Berkeley, Calif.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Sept. 13-14—International Operations and Maintenance Symposium, Airwork Corp., Millville, N. J.

Sept. 13-15—16th Annual Meeting, Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D. C.

Sept. 14-15—Ninth Annual Joint Societies Engineering-Management Conference, IRE, Hotel Roosevelt, New York, N. Y.

Sept. 15-17—Annual Convention, National Assn. of State Aviation Officials, Miami Beach, Fla.

Sept. 20-21—Industrial Electronics Symposium, Institute of Radio Engineers, Bradford Hotel, Boston, Mass.

Sept. 20-24—National Convention and Aerospace Panorama, Air Force Assn., Philadelphia, Pa.

Sept. 26-28—Annual Convention, National Business Aircraft Assn., Mayo Hotel, Tulsa, Okla.

Sept. 29-30—Society of Experimental Test Pilots' Fifth Annual Symposium and Awards Banquet, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 2-4—Seventh National Communications Symposium, Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 3-5—National Airports Conference, University of Oklahoma, Norman, Okla.

Oct. 9-13—National Aerospace Engineering & Manufacturing Meeting, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Calif.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

Oct. 14-22—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janeiro, Brazil.

Oct. 23-24—Joint Meeting, Canadian Aeronautical Institute/Institute of the Aerospace Sciences, Ottawa, Canada.

Oct. 23-27—17th Annual General Meeting, International Air Transport Assn., Sydney, Australia.

Oct. 24-26—International Symposium on Aero-Space Nuclear Propulsion, Institute of Radio Engineers, Riviera Hotel, Las Vegas, Nev.

August 7, 1961

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Complex U. S. Satellite Policies Debated **26**
▶ Senate space communications probe shows divergent patent concepts in AT&T agreement, Advent contract.

Minor Issues Used to Block New Fares **36**
▶ Analysis of IATA meeting shows prospects bleak for new promotional rates in foreseeable future.

Aerospace Corp. Responsibilities Expand **52**
▶ USAF's non-profit civilian technical planning group anticipates future state-of-the-art obstacles.

SPACE TECHNOLOGY

U. S. Satellite Policies Debated **26**
Project Relay Program **27**
Apollo Single Manned Compartment .. **29**
Space Nuclear Research Accelerated .. **33**
Grissom Reports on Second MR Flight **60**
Space Vehicle Log **61**

MISSILE ENGINEERING

Solid Rocket Components Tested **34**
Simulated Snap Fuel Tested **35**

AERONAUTICAL ENGINEERING

First Beagle Twin Details **29**
Photos Show Beauty Area Ruling **31**
Bounder Shows Soviet Design Progress **69**
More Design Details of Mi-6 .... **75**
Supersonic Transport Progress **77**
Old Tu-104 Engines Used in Mining .. **77**
NA.39 Attack Capability **81**
Production Briefing **82**

AVIONICS

Arinc Surveys Airline Avionics **85**
CalTech Calibrates 80-ft. Shock Tube **88**
Filter Center **89**
New Avionic Products **92**

BUSINESS FLYING

Gyro-Autopilot Needs No Electric Input **99**
Swedish Aircraft Features Plastic Gear **99**
Business & Utility Aircraft Shipments . **101**
Private Lines **101**

AIR TRANSPORT

IATA Carriers Split on Fare Issues ... **36**
Trunklines Adopting Youth Fare **37**
Mach 3 Transport Funds Approved ... **38**
NASA, USAF Predict Aircraft Advances **39**
Helicopter Service to Airports **40**
Beacon Approves Control Concepts ... **41**
British London Airport Authority **43**
Airline Income & Expenses—May **47**
Shortlines **50**
Airline Observer **50**

MANAGEMENT

Congress Supports Kennedy **28**
Modified Airport Bill Approved **30**
Supplemental Authority Defined **30**
Kennedy Moon Budget Approved **30**
Military Exemption Opposed **32**
Aerospace Corp. Responsibilities **52**
British Firms Pool Service Systems ... **57**
Who's Where **23**
Industry Observer **23**
Washington Roundup **25**
News Digest **35**

FINANCIAL

Aerospace Companies Show Profit ... **32**
North American's 1961 Sales **102**
Rolls Reports 1960 R&D Expenditures . **103**
New Offerings **103**

Calendar **5**
Letters **114**

EDITORIAL

Defensive Problems **21**

COVER: Soviet Hoop convertiplane is powered by two turboprop engines generating an estimated 4,000 eshp. located at each wingtip. Propellers connected directly to the turboprops power the aircraft in horizontal flight, while vertical lift is provided by two rotor systems of four blades, each housed above a streamlined pylon on top of each wingtip nacelle. Convertiplane, which is capable of transporting 100 persons and makes use of a modified An-10 fuselage, is credited to designer Nikolai Kamov (AW July 17, p. 31).

PICTURE CREDITS

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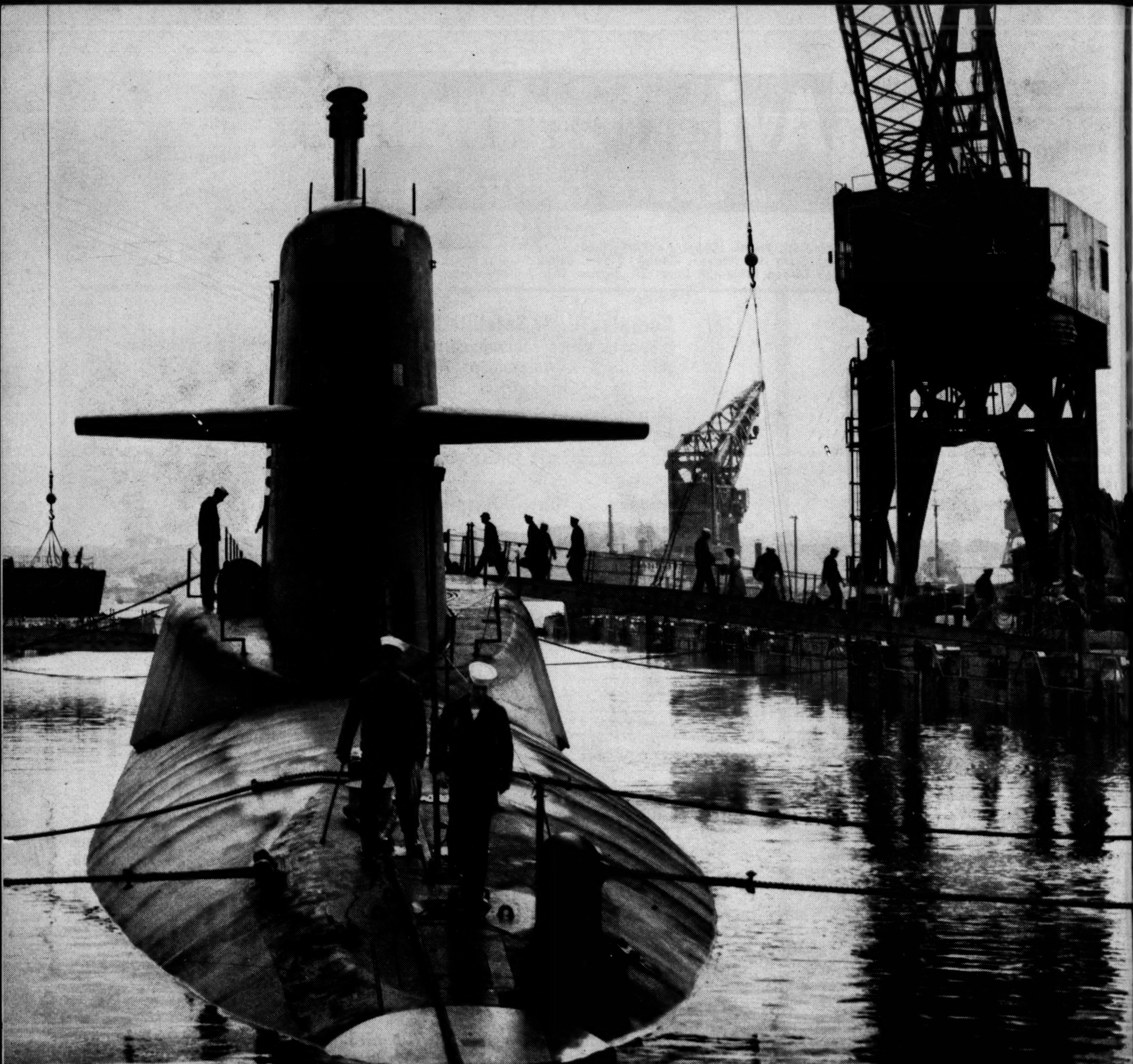

THE U.S. NAVY's

Polaris Platoon System

When a Polaris sub makes port, there's a new crew waiting to take her out again. For America cannot spare her even one day.

This platoon system keeps each sub and her 16 Polaris missiles on station continuously.

The deterrent power of Polaris grows steadily stronger—as longer-range versions are perfected, and as more Polaris subs are commissioned.

Lockheed is Polaris missile prime contractor, system manager. Major subcontractors: Aerojet-General, General Electric, Westinghouse.

LOCKHEED

MISSILES & SPACE DIVISION, SUNNYVALE, CALIF.

EDITORIAL

Defensive Problems

The problem of using offensive military weapons offers a wide choice of possibilities that can be tailored in many fashions to suit the varying national policies and purposes of the countries concerned.

For example, the fact that the Soviets are building a second generation of supersonic long-range bombers does not necessarily mean that the best U.S. policy lies in pursuing a similar course. It may be prudent to continue to bolster B-52 and B-58 strength for the immediate future to ensure that there is no possibility of a deterrent gap before large numbers of solid-fueled missiles can take over the major portion of that role. But it is becoming increasingly obvious that the development of the Mach 3 B-70 bomber offers only marginal possibilities for major military advantage for the time period into which it has now slipped.

Although the Air Force is clinging to the B-70 project with emotional fervor, many people are raising the question whether the substantial funding now being poured into the B-70 program could not be invested with more profit to the defense posture in some other, considerably more advanced methods of waging long-range offensive warfare. This is a debate that is likely to grow in intensity as the inexorable technical logic of this situation backs the blue-suited emotions into a tight corner.

When it comes to the problems of defense, however, there is no choice available except to counter the enemy's weapons. The kind of defense that this country builds is of necessity determined by the kind of weapons the Soviets develop to wage offensive warfare. Among the prime requisites in building adequate defensive forces yesterday to beat the enemy's offensive capability of today are accurate intelligence and intelligent foresight. It is always too late to research, develop, produce and deploy a defensive system if you wait until the enemy reveals his new offensive equipment, even in prototype form.

Thus, it is obvious that we should have been working on a defensive system against Soviet ICBMs even before we got the first intelligence confirmation that they had indeed embarked on the development of this type of weapon. Unfortunately, our ICBM defense effort has been confined to the single channel of the Nike Zeus approach, plus a rather thinly funded broad research study sponsored by ARPA. It is impossible to determine at this point in technology whether a successful defense can be developed against the ICBM. But history records that no "invulnerable" weapon has ever been developed and that an effective counter always appears, with its appearance timed in direct ratio to the amount of effort devoted to its development.

The current scale of our ICBM defense effort suggests that it should be increased in intensity and expanded in scope. For an effective ICBM defense offers the strong possibility of achieving strategic checkmate in a single move. The country that first develops and demonstrates an effective defense against ICBMs can rule the international roost for that period in the foreseeable future until new types of offensive weapons emerge to make the ICBM obsolete.

Although we get only faint sniffs of the Soviet effort at developing an anti-ICBM system, it would be foolish to assume that they are not pushing this program to the limit of their available technical resources. As a nation of chess players, the significance of this move could hardly be lost on the Soviet leaders.

In the same vein, we should be devoting considerable effort today to developing defensive capability against weapons that may eventually be deployed through space, even though it is not yet clear exactly in what form the space offense will emerge as a genuine threat some years hence. Such projects as the Air Force Saint (satellite interceptor) represent a sound forward step toward solving the defensive problems of tomorrow, even though its details sound like science fiction to the taxpayer today.

But one area in which we find ourselves in serious defensive difficulty is the old fashioned business of air defense against manned bombers. Based on a combination of faulty intelligence and wishful thinking, our national leaders of some years ago convinced themselves that the Soviets had abandoned manned bomber development and that it was safe to let our air defense system deteriorate into eventual obsolescence.

There is still some effort at the top level in the Pentagon to dismiss the Soviet supersonic bomber and tanker developments with the hackneyed Detroit-manufactured sneers of "The Russians aren't 10 ft. tall," and "How do we know these new Russian bombers aren't just prototypes built to fool us into going in the wrong direction?" This was the same sort of malarkey pedaled by the Central Intelligence Agency after the 1956 Tushino air show. Despite the protestations of Messrs. Dulles and Khrushchev, the Soviets have continued development of manned flying machines across the entire technical spectrum from supersonic bombers to helicopters and convertiplanes.

It is against the threat of the new Soviet supersonic bombers with their high-speed jet tanker support, combined with the old Bear and Badger bomber fleet equipped with standoff missiles of sufficient range to avoid Nike Hercules and make the Bomarc B and the F-106 systems of marginal effectiveness, that our defenses are critically weak. We once had adequate military plans to counter this future threat with the long-range F-108 Mach 3 interceptor and a modernized SAGE and DEW-Line system. But all of these plans were scrapped on the ground that no such future threat would exist.

In our current preoccupation with the development of a variety of technically sound new offensive weapons, we should not neglect a more intensive and intelligent evaluation of our future defensive requirements than we have devoted to this area in the past.

—Robert Hotz

1-6 Commutator assembly—analog input
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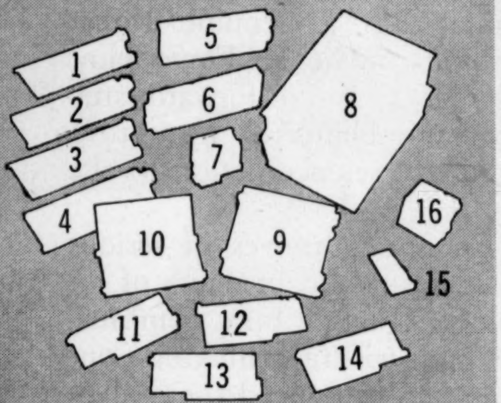

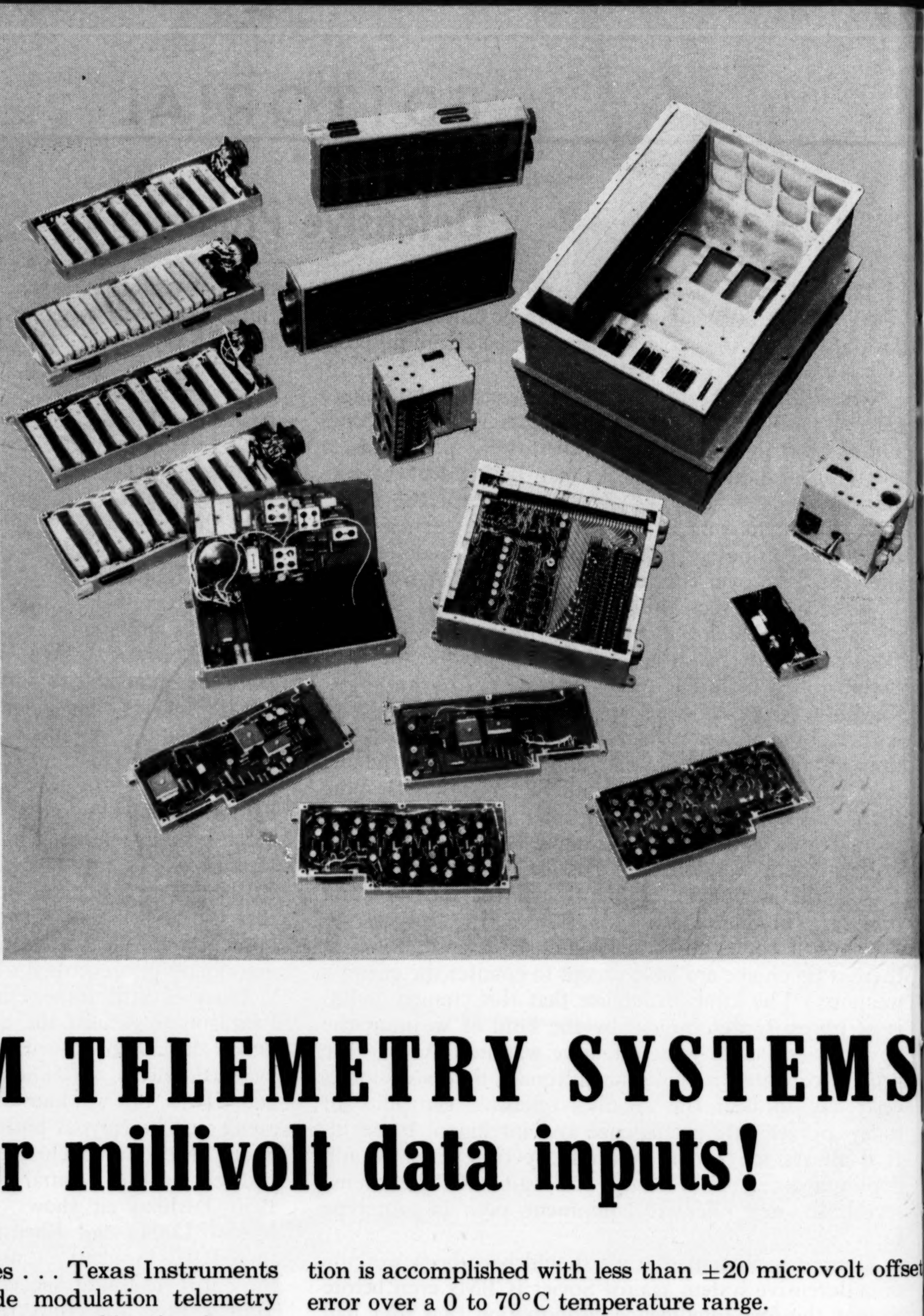

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Robert L. Turner, executive vice president-transportation services and a director of Eastern Air Lines, Inc. Also named executive vice presidents: **Maurice Lethbridge** for staff services; **Capt. John H. Halliburton** for administrative services.

Maxwell B. Bassett, vice president-systems management and a director of General Precision, Inc., Tarrytown, N. Y., subsidiary of General Precision Equipment Corp.

F. E. Rushlow, vice president, Giannini Controls Corp., Duarte, Calif. Mr. Rushlow is the company's director of marketing.

Leland W. Bagby, president, Data Technology Corp., Palo Alto, Calif.

Harry L. Benjamin, vice president-marketing and engineering, United Aircraft Products, Inc., Dayton, Ohio.

Robert C. Lockwood, executive vice president, Instruments for Industry, Inc., Hicksville, N. Y.

Telecomputing Corp., Los Angeles, Calif., has named Vice President **David T. Kimball** as general manager of both the Whittaker Controls and Whittaker Gyro Divisions.

Maj. Gen. John A. Barclay (USA, ret.), vice president-research and development, The Lionel Corp., New York, N. Y.

Dave Gerstein, vice president-government and industrial operations, Olympic Radio and Television Division of the Siegler Corp., Los Angeles, Calif.

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Richard E. Fisher, vice president and director of public relations, Northeast Airlines, Inc.

William Weitzen, regional vice president, Washington, D. C., area operations, Autometric Corp.

W. O. Chamberlin, vice president-marketing, Brooks & Perkins, Inc., Detroit, Mich.

Willard L. Landers, formerly vice president-operations for Fairchild Stratos Corp., now production chief for Umbaugh Aircraft Corp., Hagerstown, Md.

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Col. Karl N. Retzer, chief of the Electronic Systems Division's 425L System Program Office, Air Force Systems Command, Hanscom Field, Mass.

Col. James D. Hunter, information chief of the Secretary of the Air Force's Los Angeles (Calif.) Information Office.

Honors and Elections

B. C. Vallieres, managing director of Avions Dassault, has been elected president of the French Aircraft and Space Industry Assn.

(Continued on page 105)

INDUSTRY OBSERVER

▶ Dyna-Soar landing sites for the initial suborbital test flights will be at Mayaguez, Puerto Rico; Santa Lucia Island and Recife, Brazil. These sites are approximately 1,100, 1,600 and 4,200 mi. respectively from Cape Canaveral.

▶ **First Centaur test launch is scheduled for November. It will be a ballistic flight.**

▶ Air Force plans to fly the Centaur inertial guidance system piggyback on an Atlas missile within several months. The Centaur guidance system consists of a four-gimbal, gyro stabilized platform made by Minneapolis-Honeywell and a Librascope digital computer (AW Dec. 6, p. 65).

▶ **Navy's Radiological Defense Laboratory is conducting a series of 18 underwater chemical high-explosive detonation tests off San Clemente Island in a study of nuclear anti-submarine weapon effects. Study is called Project Hydra II but is unrelated to the Project Hydra sea launch concept.**

▶ National Aeronautics and Space Administration plans to buy at least five and possibly 10 more Lockheed Agena B upper stages by early 1963 in addition to the five now programed. The vehicles will be used in tests of various Apollo systems.

▶ **Research chamber now in operation at Arnold Engineering Development Center can produce partial vacuums as low as 4.7×10^{-9} millimeters of mercury, equivalent to pressure at about 375 mi. altitude. Working space is 8 ft. in diameter and 15 ft. long. Low pressure is achieved with oil diffusion pumps equipped with liquid nitrogen-cooled baffles and with mechanical pumps. Later, the facility will use cryo-pumping, which involves condensing gases on very cold surfaces.**

▶ Air Force and Douglas are attempting the first precise correlation of aircraft structural fatigue produced in flight with fatigue produced by test rigs. Mission profiles are being flown by a C-133 transport and duplicated in a water test tank at the Douglas Long Beach plant. The program is expected to improve validity of projections based on ground tests.

▶ **Air Force is showing increased interest in radioisotope sensing devices for use in very high altitude aircraft. A radioisotope laboratory will be established soon in the Flight Control Laboratory at Aeronautical Systems Division to evaluate such devices as radioisotope altimeters, accelerometers and densimeters.**

▶ Mil flying crane helicopter demonstrated at the recent Tushino air show can lift 15 metric tons (33,075 lb.), according to a Russian technical source. The Mi-6, from which the flying crane was developed, has lifted 12 metric tons to an altitude of 7,870 ft.

▶ **Saturn launch Complex 37 at Cape Canaveral will accommodate finned boosters. Launches will be moved from Complex 34 to Complex 37 after the first four flights while 34 is being converted to handle liquid hydrogen.**

▶ Titan II launch complex at Cape Canaveral—consisting of modified Titan I pads 15 and 16—is almost complete. With Titan II storable fuel tankage now installed within the explosive fuel storage area, the Army Corps of Engineers has restricted a 10,000 ft. radius, semi-circular area in the adjacent Banana River as a safety precaution.

▶ **Mercury-Atlas 6 capsule may carry a chimpanzee on an orbital flight if MA-4, carrying a "mechanical" man in orbit, and MA-5, the first orbital chimp flight, are not completely successful. If the first two orbital tests are completely successful, MA-6 will be a manned flight.**

▶ Avro disk-shaped VTOL research vehicle is now undergoing test and evaluation at NASA's Ames Research Center.

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Washington Roundup

Sole-Source Buying

Pentagon has two specific actions under way to begin reversing the trend to sole-source procurement, but Defense Secretary Robert McNamara has warned Congress that it may take five years to realize dollar savings. He sees no hope of making inroads into sole-source buying of major items such as aircraft in the near future.

Industry is not likely to welcome the main device he plans to use—requiring that drawings and specifications under any development contract be prepared according to a specific timetable so they can be turned over to competitors immediately when the time comes to bid on procurement of the item.

McNamara's second step is to have a group under Sterling Livingston review all sole-source procurement procedures in a search for other ways to reverse the trend. McNamara explained to the House Armed Services Committee that there is only one source for the Lockheed C-130s and Republic F-105Ds needed for the rapid buildup of conventional forces, for example—and to tool a second plant would take too long. For reasons such as these, savings lie only in the future. "But I can absolutely guarantee the action we are taking will lead to that result eventually," McNamara said.

Total Budget Picture

Congress has received a diplomatic suggestion from Budget Bureau Director David E. Bell that it establish its own equivalent of the Budget Bureau. By acting separately on fragments in the budget, Congress now avoids responsibility for the final total figure. Budget Bureau must test one program against the other and all programs against expected revenue in forming a national budget.

Tight control placed on the military services' Study Requirements at the Defense Department level will continue for an indefinite period. The reasoning is that companies assign their most talented scientists and engineers to the studies, whether they're funded or unfunded, and that more immediate high priority projects suffer as a result. Air Force, with many ideas for military space applications, has encouraged the greatest number of studies.

Soviet Cosmonaut Yuri Gagarin apparently has been stung by the widely-drawn comparison between U. S. Astronaut Alan Shepard's flight—in which Shepard controlled his capsule briefly—and Gagarin's own flight. Gagarin has never claimed that he "flew" his spacecraft, has agreed with Soviet statements that it was controlled from the ground. But he told an interviewer on his recent trip to Cuba: "It seems to me there is no point in sending a man into space unless the operation is managed by the man. I was the direct controller of the flight. I directed the entire flight of the space ship."

Anti-Trust Threat

Possibility that the U. S. might ask American Telephone & Telegraph Co. to divest itself of its overseas operations has further complicated the communications satellite question (see p. 26). Assistant Attorney General Lee Loevinger, who heads Justice Department's Anti-trust Division, said under questioning by the Senate Small Business Subcommittee on Monopoly last week that this question is under consideration. He later tried to modify the statement, but his remarks had dropped the company's stock by $4.62 and brought a protest from company spokesmen. Overseas telephone calls represented one-half of one per cent of AT&T's business last year, but these calls are expected to grow by a factor of 25 by 1980—and it is chiefly for this reason that AT&T wants a communications satellite.

President Kennedy's letter to Commerce Secretary Luther Hodges asking for recommendations on improving the nation's transportation industry represents a shift in Administration planning. Earlier this year, presidential assistant James Landis recommended that the White House study federal regulatory agencies—and it appeared that Landis probably would be asked to develop an over-all transportation and communications plan.

Commerce moved into the picture with a message drafted last spring for the President's delivery to Congress. It was deferred because of more pressing problems, but it undoubtedly prompted the White House to take action on the transportation issue at this time. President Kennedy has asked that the recommendations be in his hands by Nov. 1. He will send them to Congress next year.

Pentagon Tonic

Latest suggestion making the rounds of Pentagon offices is to combine Navy's Bureau of Ships (BuShips) and Bureau of Weapons (BuWeps) to form BuSchweppes. Its chief, of course, would be Vice Adm. Robert Burns Pirie, the only U. S. Navy admiral with a beard.

Col. Otto Glasser, chief of Air Force Systems Command's Special Projects Office and special assistant to AFSC Commander Gen. Bernard A. Schriever, is working for 90 days in National Aeronautics and Space Administration's Large Launch Vehicle Planning Group, apparently as a USAF representative in the NASA-Defense Joint Lunar Study Project.

—Washington Staff

Complex U. S. Satellite Policies Debated

Senate space communications probe shows divergent patent concepts in AT&T agreement, Advent contract.

Washington—Growing complexity of the government-industry relationships developing in the communications satellite field was brought into sharp focus last week as the Senate Monopoly Subcommittee opened hearings on space communications.

Two widely divergent approaches have emerged in Army's contract with the Bendix Corp. for the Advent military communications satellite and a cooperative agreement between National Aeronautics and Space Administration and American Telephone & Telegraph Co., which features stringent anti-monopoly restrictions and gives the government liberal rights to AT&T technical developments.

Chairman Russell Long (D.-La.) protested that the Army contract gives Bendix exclusive commercial patent rights to new technical developments made under the Advent program.

Bendix is prime contractor for the communications system for the Advent, involving synchronous orbit systems with the satellite at an altitude of 22,300 mi., hovering over a fixed point on the equator.

"This is a case in which a single contractor has the power to say the know-how developed with public funds will not be available in the public interest," Sen. Long said. "Only the military has the right to use the know-how."

John H. Rubel, assistant secretary of defense and deputy director of defense research and engineering, in his testimony to the subcommittee pictured Advent as "the most promising space vehicle for communication via satellites." He said that "most of the technology is directly applicable to the development of non-military systems."

Long Criticizes FCC

Sen. Long also was critical of the original proposal of Federal Communications Commission to limit participation in a satellite communications system to present international common carriers, dubbing it a "chosen instrument" policy. He objected that only four of the nine international carriers have an interest in participating and that AT&T would have 85% of the ownership.

Lee Loevinger, assistant attorney general in charge of the Justice Department's Anti-trust Division, told the subcommittee that although Justice has adopted a "flexible" attitude toward the ownership structure of a space communications system, the department has a firm position on these three points:

- **That there must be** a broad base of ownership, as well as accessibility to use of the system;
- **That there must be no** "prime contractor" arrangement, with the prime dealing with other ownership participants as subcontractors;
- **That the government**—and not private ownership participants—must pass on foreign ownership participation.

Originally, Justice took the position that equipment manufacturers—as well as international common carriers—"must" be permitted to participate in ownership. In view of FCC objections that this would be "too cumbersome" a situation in the first phase, Loevinger said, Justice altered its position. FCC established an ad hoc carrier committee to submit recommendations on ownership, and left the door open for broadening participation later.

Meanwhile, FCC Chairman Newton Minow emphasized in testimony before the Senate Commerce Communications Subcommittee that rigid ground rules have been set for all discussions of the carrier committee to avoid anti-trust violations and that sessions will be conducted under the surveillance of an FCC representative.

The commerce subcommittee, headed by Sen. John O. Pastore (D.-R. I.), is considering legislation creating a commission to make a thorough study of the radio spectrum and establish an allocation policy. Frequencies have been allocated on a piecemeal basis with the result that "no one knows exactly" what the unallocated portion is or whether it is adequate for the requirements of a space system, according to the subcommittee staff.

Douglas Reorganization

Los Angeles—Douglas Aircraft Co. has begun a major reorganization which will divide corporate responsibilities between a Missiles and Space Division and an Aircraft Division.

A comparatively small general offices section will remain to set corporate policy and provide coordination if necessary. The new organizational pattern is based on product lines rather than geographic lines, as it formerly was. Former geographic divisions at Charlotte, N. C., Tulsa, Okla. and elsewhere will function in the division appropriate to their products. The Aircraft Division will be headed by Jackson R. McGowen and the Missiles and Space Division will be headed by Charles R. Able.

As part of the reorganization, Douglas is beginning a facilities modernization program.

Noting that the Administrative Radio Conference is scheduled to meet in Geneva in 1963 for international negotiations on the allocation of frequencies, particularly for space communications, Sen. Pastore commented "we must be fully prepared."

Bendix Corp. is scheduled to testify Aug. 9 before the Long subcommittee. Other companies scheduled include Rand Corp., Radio Corp. of America, General Electric Co. and Lockheed Aircraft Corp.

Under the civilian agency's agreement, NASA will launch AT&T-built satellites in April and October, 1962, with two additional vehicles to be available as backups—or optional launches in June and December if the first two prove successful.

Standard patent provision of the 1958 Space Act reserves for NASA the rights to inventions developed under NASA contract. With AT&T, however, NASA has extended this provision, under a waiver added to the agreement, to include any inventions made after May 18, 1961 in the course of AT&T-sponsored research which advances the state of the art in satellite communications.

NASA General Counsel John A. Johnson said in a press conference that "We have gone beyond inventions that might be strictly determined to be made under the agreement, and we have agreed with AT&T that, with respect to other inventions that might be made during the period of this agreement, beginning on May 18th of this year and running through to the end of the launch phase, that if they make any inventions during that period in the course of performing AT&T's sponsored research and development projects that are directed toward improving the art of satellite communications, that we will have a royalty-free license for the government so far as those inventions are concerned and also will be able, in those cases, to grant royalty-free licenses to others for the use of these inventions in satellite communications systems or in the production of components for employment of those systems."

NASA distinguishes two categories of AT&T inventions made after the May

18 initiation of negotiations—those which are developed directly for the experimental satellite system and those which are developed under research projects independent of the agreement, but which are applicable to the satellite or to the field of satellite communications.

Over the former category, Johnson said that NASA's rights are "unlimited" and "not in any way limited to use in communications satellite systems or even in the field of communications generally. He also indicated that royalty-free licenses for this group of inventions might be extended to foreign governments which have general licensing rights with the U.S. under existing treaties.

With the latter group, NASA reserved the standard right to the U.S. government, but also added that royalty-free licenses can be granted to other companies engaged in satellite communications.

Net effect of these restrictions, Johnson said, is to prevent "any possibility of AT&T developing or increasing a monopolistic position during this period as a result of their inventive activity, which might be supported by the United States."

Dr. Robert C. Seamans, NASA associate administrator, said the two AT&T satellites will conduct wideband communications experiments, including television, two-way telephone, radio and telegraphy, between company-owned stations at Rumford, Me., and Holmdel, N. J.

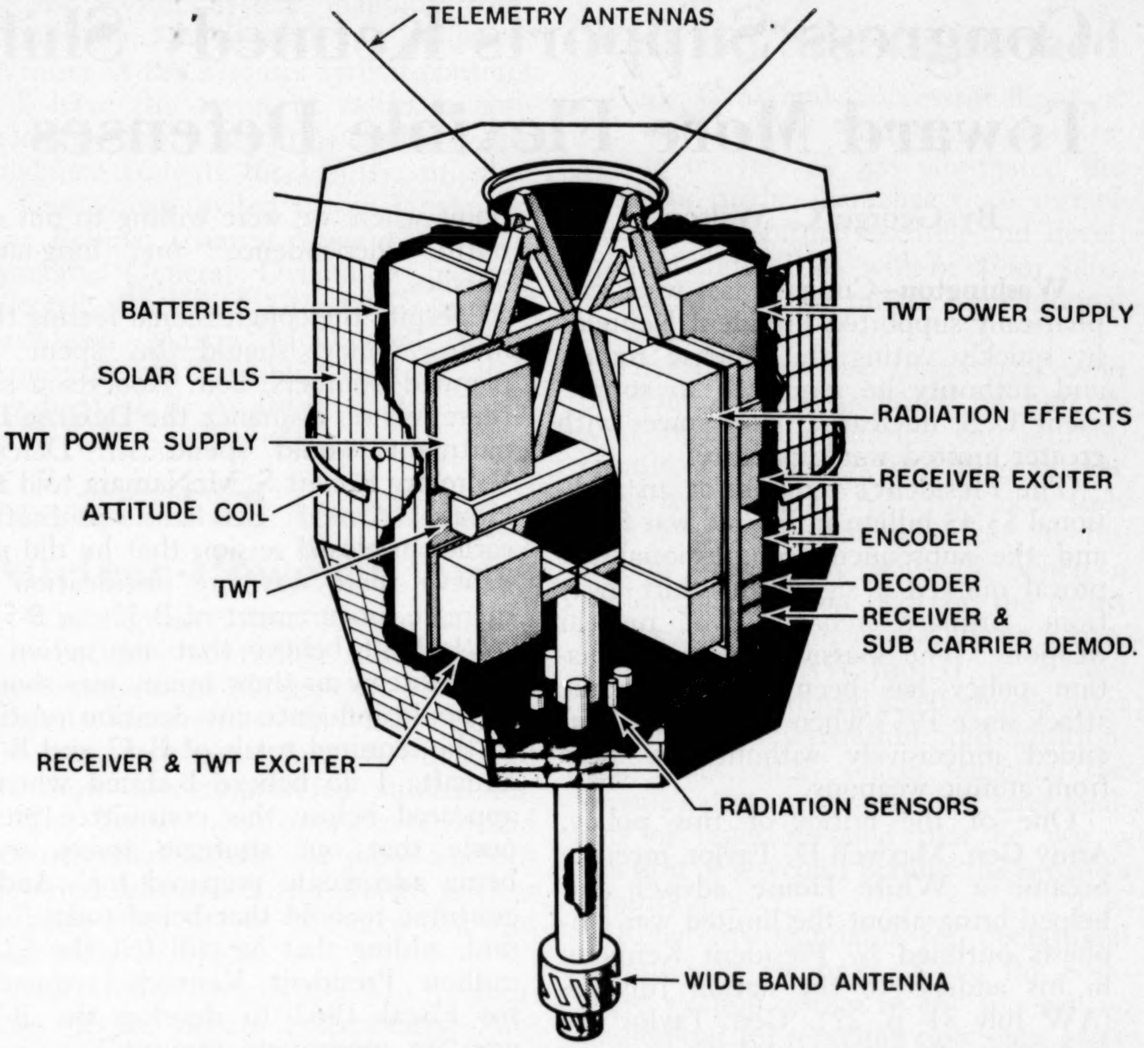
Dr. Seamans said that NASA had informed the other nations participating in the Relay program about the AT&T experimental project but that no country had yet decided to participate.

Elliptical Orbits

The spherically-shaped AT&T satellites, weighing 125 lb. each, will be launched into elliptical orbits approximately 600 mi. at perigee and 3,000 mi. at apogee. Inclination to the equator will be 45 deg.

Using a single transponder and a 3-watt traveling wave tube, powered by solar cells and nickel-cadmium batteries, the satellites will transmit to the ground stations on a frequency of 4,170 mc. Ground station-to-satellite frequency will be 6,390 mc. at 2 kw.

Under the cooperative agreement, NASA will provide the Thor-Delta launch vehicle, launching and tracking facilities, range and launch crew services, telemetry and data acquisition. AT&T will reimburse NASA for all costs incurred, and Dr. Seamans estimated the total price of one firing to be about $6 million, with the launch vehicle and launch operations amounting to $3-$3.5 million of that total.



NASA'S active communications satellite, Relay, is scheduled to be launched in 1962 from Cape Canaveral, using a Thor-Delta launch vehicle. RCA will develop the spacecraft.

Germany, Brazil Expected to Join NASA's Project Relay Program

Washington—Germany and Brazil, and possibly Canada and Japan, are expected to join England and France as participants in the National Aeronautics and Space Administration's Project Relay communications satellite program.

NASA also has received inquiries from Argentina and Italy, but has not yet held detailed discussions with these two countries.

NASA chief of communications satellite programs, Dr. Leonard Jaffee, discussing ground stations, told a press conference: "We have a strong indication of interest from the Germans and Brazilians. We do not have a firm agreement yet with these people [but] we expect that we will have.

"We have had conversations with the Japanese and Canadians. They have expressed an interest. In the case of the Japanese, for the first two experiments —both Relay and the Bell [American Telephone & Telegraph Co.] projects —the orbital altitude will probably be too low to provide significant communications time between the U. S. and Japan. But they are extremely interested and will probably want to cooperate with the U. S. in any follow-on program."

NASA is negotiating a $3.25-million contract with Radio Corp. of America for development of the Relay satellite system.

The octagonal-shaped satellite (AW Jan. 30, p. 93), to be launched next year from Cape Canaveral on a Thor-Delta launch vehicle, will carry two transponders and a 10-watt traveling wave tube. Ground-to-satellite frequency will be 1,725 mc.; satellite-to-ground frequency will be 4,170 mc. A very-high-frequency transmitter will provide a tracking signal for orbit determination.

Orbit will be elliptical, with a perigee of about 900 mi. and an apogee of about 3,000 mi.

Inclination to the equator will be approximately 48 deg.

Power will be drawn from 6,000 solar cells. Both the Relay and AT&T satellites will carry instrumentation to measure intensity and distribution of protons and electrons in space and to determine the extent of damage inflicted by these particles on solar cells.

Ground stations in the Relay system will experiment with various receiving and tracking antennas, helium-cooled masers and solid-state devices.

Congress Supports Kennedy Shift Toward More Flexible Defenses

By George C. Wilson

Washington—Congress last week emphatically supported President Kennedy by quickly voting the defense money and authority he requested to supplement U. S. nuclear striking power with greater limited war capability.

The President's request for an additional $3.45 billion in limited war funds and the subsequent congressional approval marked a significant shift away from primary reliance on nuclear weapons. The massive nuclear retaliation policy has been under sporadic attack since 1953 when the Korean War ended indecisively without any help from atomic weapons.

One of the critics of this policy, Army Gen. Maxwell D. Taylor, recently became a White House adviser and helped bring about the limited war emphasis outlined by President Kennedy in his address to the nation July 25 (AW July 31, p. 22). Gen. Taylor has said that "massive retaliation as a guiding strategic concept has reached a dead end and there is an urgent need for a reappraisal of our strategic needs."

In its place, Gen. Taylor called for a strategy of flexible response—"a capability to react across the entire spectrum of possible challenge, for coping with anything from general atomic war to infiltrations and aggressions such as threaten Laos and Berlin. . . . The new strategy would recognize that it is just as necessary to deter or win quickly a limited war as to deter general war. Otherwise, the limited war which we cannot win quickly may result in our piecemeal attrition or involvement in an expanding conflict which may grow into the general war we all want to avoid."

Senate Exceeds Request

President Kennedy's defense message called for attaining this "flexible response," partly by strengthening military manned aircraft and missile capability. The Senate subcommittee went even farther than the President requested by voting an additional $228,840,000 for development of the B-70 and $525 million more to extend production of long-range bombers.

Sen. A. Willis Robertson (D.-Va.), acting chairman of the Defense Department Appropriations Subcommittee, said these committee additions as well as those sought by the President amounted to a "prudent reinforcement of the conventional strength of our military forces. It's a balanced program. We thought we had not reached the point where we were willing to put our entire dependence on long-range missiles."

Despite the congressional feeling that more money should be spent on manned bombers, Sen. Robertson said there was no assurance the Defense Department would spend it. Defense Secretary Robert S. McNamara told the House Armed Services Committee earlier in closed session that he did not believe there was any justification to increase procurement of B-52s or B-58s.

"I don't believe that any action at the Moscow air show in any way should or would influence any decision relating to the required totals of B-52 and B-58 aircraft. I do believe I stated when I appeared before this committee previously that our strategic forces were being adequately prepared for. And I continue to hold that belief today," he said, adding that he still felt the $220 million President Kennedy requested for Fiscal 1962 to develop the B-70 was "an appropriate amount."

Nuclear Capability

As to whether the limited war buildup means departing from the massive retaliation policy altogether, McNamara said "definitely not." He said "among other reasons for proposing the actions we have taken to accelerate the 50% ground alert status of our bomber forces and to continue on active duty B-47 wings is the objective of making clear that we are not neglecting our nuclear capabilities, but we are continuing to strengthen them."

Despite such close questioning on the specifics and general policy implications of the President's defense message, Congress moved quickly to provide the money and authority requested.

- **Defense budget.** Senate appropriations committee gave President Kennedy everything he requested in his July 26 message to Congress, resulting in a recommendation to spend $46,848,292,000 on defense in Fiscal 1962. "The committee is convinced," the report said, "that these large appropriations are required at this time to safeguard the security of the nation."
- **Bomber money.** Senate appropriations committee said it voted to appropriate $228,840,000 more than the $220 million the Kennedy Administration asked for the B-70 because "we view the B-70 cutback and stretchout with grave concern and serious reservations. We question whether this nation can afford to place full dependence on an operationally untried and untested missile force. . . . In case of a nuclear ban, ballistic missiles would be useless. . . . We feel the B-70 offers the most advanced step in manned strategic systems for the operational inventory."

The committee asked the Defense Department to report by Jan. 1, 1962, on its plan to get the B-70 operational at the earliest possible date. The committee, in appropriating $525 million additional for long-range bombers, did not specify whether the money should go for the B-52 or B-58. Sen. Robertson said it would be up to the Pentagon to decide which bomber to buy with the money, recalling that Air Force Chief of Staff Curtis E. LeMay had testified that he considered the B-58 a long-range bomber.

- **Defense advertising.** The committee modified the language in the House-passed appropriation bill pertaining to advertising. The changes follow substantially those recommended by the Defense Department to narrow the scope of the rule. The section in the Senate bill says: "No part of the funds appropriated herein shall be available for paying the costs of advertising by any defense contractor, except advertising for which payment is made from profits, and such advertising shall not be considered a part of any defense contract cost. The prohibition contained in this section shall not apply with respect to advertising conducted by any such contractor, in compliance with regulations which shall be promulgated by the Secretary of Defense, solely for (1) the recruitment by that contractor of personnel required for the performance by the contractor of obligations arising under a defense contract, (2) the procurement of scarce items required by the contractor for the performance of a defense contract, (3) the disposal of scrap or surplus materials acquired by the contractor in the performance of a defense contract, (4) the procurement of subcontractors required for the performance by the contractor of his obligations under a defense contract, or (5) costs of participation in exhibits upon invitation of the government."
- **Manpower.** House and Senate authorized President Kennedy to activate 250,000 reservists, extend the tours of those already in service by 12 months.
- **Procurement authority.** Senate and House unanimously passed the authorization bill necessary to enable the Defense Department to spend $958,570,000 to procure more aircraft, missiles and naval vessels. The money is to be divided this way: aircraft, Army $36.7 million, Navy and Marine Corps $281.4 million, Air Force $294.1 million; missiles, Army $33.7 million, Navy $262.2 million, Air Force $8.8 million; Navy vessels, $41.6 million. No new additional authorization legislation is needed for the other military equipment President Kennedy will buy.

Saturn Studies

Washington—Contracts to study design problems involved in flight testing a nuclear rocket engine in an upper stage of a Saturn booster were awarded to Martin, Lockheed, General Dynamics/Astronautics and Douglas last week by NASA's Marshall Space Flight Center.

Each contract is for about $75,000, and the studies are to be completed this year. These contracts follow paid studies performed earlier by Lockheed and Martin and unpaid studies done by Douglas and General Dynamics under the Reactor In-Flight Test Program (RIFT). The new contracts will produce preliminary designs for the nuclear stage.

Apollo to Have Single Manned Compartment

Washington—One compartment will serve both as the mission and command module of the Apollo spacecraft, according to specifications set forth in a proposal request issued to 12 companies by the National Aeronautics and Space Administration July 28.

The design approach sought from prospective contractors appears to be similar to that formulated by NASA's own Space Task Group and Ames Research Center.

Of the four preliminary design studies recently presented to NASA by Convair, General Electric, Martin and STG-Ames, only the NASA concept, incorrectly identified by Aviation Week (July 31, p. 29) as the Convair vehicle, combined the two modules into one. The companies each stressed separate compartments.

The NASA concept envisioned a symmetrical, blunt-ended vehicle, 135.6 in. long and 160 in. in diameter, with a volume of 430 cu. ft. and weighing about 8,500 lb. An offset center of gravity would cause the vehicle to pitch up at a fixed angle of attack during reentry, thus resulting in a lift-to-drag ratio of 0.5. Roll jets would provide the pilot of the Apollo vehicle with the ability to control the direction of lift.

Total weight of the NASA Apollo craft, including the propulsion system and a full load of fuel, was 25,100 lb.—considerably above the 15,000-lb. limit originally set by NASA. Since Convair, General Electric and Martin also exceeded the weight figure, NASA has decided that the Saturn C-3 vehicle will have to replace the C-2 for circumlunar flights (AW June 19, p. 26).

Management portion of the proposal request was understood to be extremely probing. NASA has also specified a modified version of the PERT system as a management tool.

The proposal request indicated that there will be a separate procurement for the avionics system, including communications, navigation and guidance. Winner of the avionics system contract will have the status of associate contractors, similar to firms building the guidance systems for ballistic missiles.

Companies invited to bid for Apollo are: Boeing, Chance Vought, Douglas Aircraft, General Dynamics, General Electric, Goodyear Aircraft, Grumman, Lockheed, Martin, McDonnell, North American and Republic Aviation. Bids are due Oct. 9. Award is expected to be made before end of the year.

Soviets Fail to Show Nuclear-Powered Subs

Washington—Soviet Russia paraded automatically controlled rocket-launching vessels about the size of U. S. patrol torpedo boats at its Navy Day celebration near Leningrad July 30, but failed to show nuclear-powered submarines.

The Soviet newspaper Izvestia said recently that Russia has more nuclear-powered submarines armed with nuclear missiles than the U. S. Navy has, and said they are faster.

Sen. John Stennis (D.-Mo.), chairman of the Senate Preparedness Subcommittee, said after a closed briefing by Navy officials last week, that "we can't just write off the Soviet's claims" about nuclear missile subs, but said "I definitely don't think they surpass us." Sen. Henry M. Jackson (D.-Wash.), another subcommittee member, said flatly "they are behind."

Meanwhile, Dr. Egbert von Frankenberg and Proschlitz, a Communist East German military-political commentator, said in a television analysis of the recent Russian air show at Tushino (AW July 17, p. 31) that Russia finds aircraft still useful for reconnaissance, antisubmarine warfare, ground support, transport and interception, in spite of the increasing importance of rockets.

But he said that "under modern conditions, no big bomber squadrons are needed. As in World War II, planes armed with nuclear weapons or rockets would fight individually. In this connection, the tactical use of bombers against pinpoint targets, for example, aircraft carriers, is especially important."

The commentator compared the Lockheed F-104G, which West Germany will use, with what he called the Sukhoi-4 fighter displayed at Tushino. The figures he used for the F-104 apparently apply to earlier models than the G. His comparisons were: takeoff weight, 22,400 lb. for Starfighter, 15,994 lb. for the Sukhoi; top speed 1,116 mph. for the Starfighter, 1,302 for the Sukhoi; climb rate, 175 fps. for the Starfighter, 337 fps. for the Sukhoi; ceiling, 55,777 ft. for Starfighter, more than 65,600 ft. for Sukhoi.

Later Minuteman Tests Will Be Silo-Launched

Cape Canaveral—Successful flight of the third USAF Minuteman ballistic missile on July 27 has eliminated the need for further launches from surface pads and all future research and development flight tests will be from silos, which will be the missile's operational environment.

First flight of the three-stage, solid propellant ICBM occurred on Feb. 1, with all stages separating and igniting cleanly. Staging was also good on the most recent flight. Air Force now feels that a good missile was lost in the second launch on May 19, when a soldered connection between the thrust vector control unit and a nozzle activator came loose (AW July 31, p. 35) and the missile destroyed itself shortly after second stage separation and ignition. The range safety officer triggered the missile's destruct system, but later analysis of tapes revealed that he was a fraction of a second behind the missile's explosion.

Reliability standards for operational Minuteman are high. Since the complete weapon system in any silo will be hauled out for recycling only once every three years, the motors on each stage must be guaranteed for that time. More critical assemblies, however, such as guidance, will be recycled more frequently—at least once a year. Air Force plans to gradually increase time-between-recycles for the Autonetics all-inertial system up to three years. Maintenance costs, spread over a five-year period, are expected to be 1% of the initial in-silo cost.

Beagle Twin Details

London—Design of the new Beagle twin-engine five-passenger executive airplane, scheduled for unveiling Sept. 4 at the annual Farnborough air show, is dominated by a swept tail and dorsal fin ending just aft of the cabin.

Cabin and nose section somewhat resemble that of the Beech Baron twin, with entry door just above the wing root. Powerplants are two Continental engines built under license by Rolls-Royce.

The plane is about 32.5 ft. long and has a wingspan of 38 ft., with wing dihedral of five to six degrees. Height from ground to tip of tail is about 11 ft. and profile view features a tail cone extending aft of the horizontal stabilizer. Wing tapers from about 6.5 ft. at the root to 3.5 ft. at the tip, and has double slotted flaps. Fuel, probably about 150 gal., is carried in integral tanks.

Tricycle gear plane, first completely new design by Beagle, may make its initial flight this week.

Kennedy Moon Budget Approved by Senate

Washington—Senate last week approved the full $549 million requested by the President to accelerate National Aeronautics and Space Administration's lunar program in passing the Fiscal 1962 independent offices appropriation bill.

The request was submitted too late for consideration by the House when it acted on the legislation. Thus, it will be one of the items for determination by a joint House-Senate conference committee.

The Senate concurred in a $35-million House reduction in other NASA programs: $4.9 million for salaries and expenses, $17.5 million for research and development, and $12.8 million for construction of facilities.

House-Senate differences placed before the joint conferees included:

- **Civil Aeronautics Board.** The Senate restored a $6.9-million cut by the House and voted the full $81.7 million asked by CAB for airline subsidies. This included $6.9 million for helicopter services, compared with the $5 million allowed by the House. A move on the Senate floor, led by Sen. John Williams (R.-Del.) to eliminate the entire $6.9 million for helicopter lines was defeated 63-26. Senate confirmed a $150,000 House cut in CAB's $9-million request for salaries and expenses.
- **Federal Aviation Agency.** The Senate made three increases over funds voted by the House in FAA's budget: $12.6 million for operations, $4.6 million for facilities and equipment, and $2 million for development of a supersonic aircraft (see p. 38). It eliminated $6 million added by the House to the FAA request to speed construction of Dulles International Airport. The total FAA budget voted by the Senate was $7.6 million below the agency's $744-million request, and $13 million more than the amount approved by the House.

Modified Airport Bill Approved by House

Washington—House voted last week to authorize $375 million over five years to help states build and improve airports—with an amendment to prevent the Federal Aviation Agency from operating an airport at Mitchel Field, N. Y. if local officials object.

The House-passed legislation differs basically from the bill pending in the Senate on how the airport money is to be appropriated. The House measure gives the appropriations committees the power to decide how much money shall be spent each year for airports, while the Senate bill would authorize the FAA to commit federal funds well in advance.

Under the Senate bill, the FAA could get the necessary money directly from the Treasury Department if Congress did not appropriate it. The Kennedy Administration favors this approach (AW July 10, p. 41).

Chairman John Bell Williams (D.-Miss.) of the House Transportation and Aeronautics Subcommittee said the bill provided a compromise between year-to-year funding and the so-called "backdoor spending" method. Under the bill, he said, Congress could appropriate enough money in one year to last the five-year period authorized.

Rep. Steven B. Derounian (R.-N. Y.) offered the amendment relating to Mitchel Field, which lies in his district. He said he wanted to "clarify" the situation there, where there is a major fight over whether part of Mitchel Field should be used for an airport after it becomes surplus property. FAA Administrator Najeeb E. Halaby has been pressing to use about half of the Air Force base for a general aviation airport.

Chairman Oren Harris (D.-Ark.) of the House Interstate and Foreign Commerce Committee raised no objection to the amendment but reserved the right to oppose it once the airport bill goes into a House-Senate conference to compromise differences.

Senate Group Defines Supplemental Rules

Washington—Senate Commerce Committee last week unanimously approved a bill to establish guidelines for Civil Aeronautics Board regulation of supplemental air carriers.

For the first time, the bill defines "charter service" for supplemental as well as scheduled carriers. The measure would give CAB less authority than it formerly had over supplemental carriers by requiring the Board to follow specific criteria set forth by Congress.

However, the bill liberalizes the present restrictions regarding charter service by allowing supplementals as well as scheduled carriers to transport people on expense-paid tours, regardless of whether they all belong to the same organization. The supplementals have mapped elaborate plans to transport Europeans to the U. S. on expense-paid tours.

The Senate bill defines charter service as "air transportation performed by an air carrier holding a certificate of public convenience and necessity where the entire capacity of one or more aircraft has been engaged for the movement of persons and their baggage or for the movement of property on a time, mileage, or trip basis, but shall not include transportation services offered by an air carrier to individual members of the general public or performed by an air carrier under an arrangement with any person who provides or offers to provide transportation services to individual members of the general public, other than as a member of a group on an all-expense-paid tour."

A restrictive section in the bill would require the CAB, before giving supplementals individually ticketed authority, to determine that there would be no "significant" diversion of traffic from existing airlines. A committee spokesman said the net effect of this provision would be to require the supplemental carriers to stipulate the points they would serve rather than permitting them to fly anywhere they wish under the individually ticketed authority. Also, the CAB would have to show the proposed supplemental service was a public necessity.

Another section of the bill would simplify procedures for the supplementals to follow when seeking business that the scheduled carriers could not handle. In peak traffic periods, CAB could issue supplementals special 30-day operating authority. The authority could be renewed twice for a total period of 90 days. The bill also would empower the CAB to fine supplementals up to $1,000 for each day they violated regulations.

The House Transportation and Aeronautics Subcommittee has approved a bill giving the CAB more latitude over the supplementals than would be allowed in the Senate measure. But the parent House Interstate and Foreign Commerce Committee has not approved the bill. Supplemental air carriers currently are operating under temporary congressional authority scheduled to expire in March, 1962.

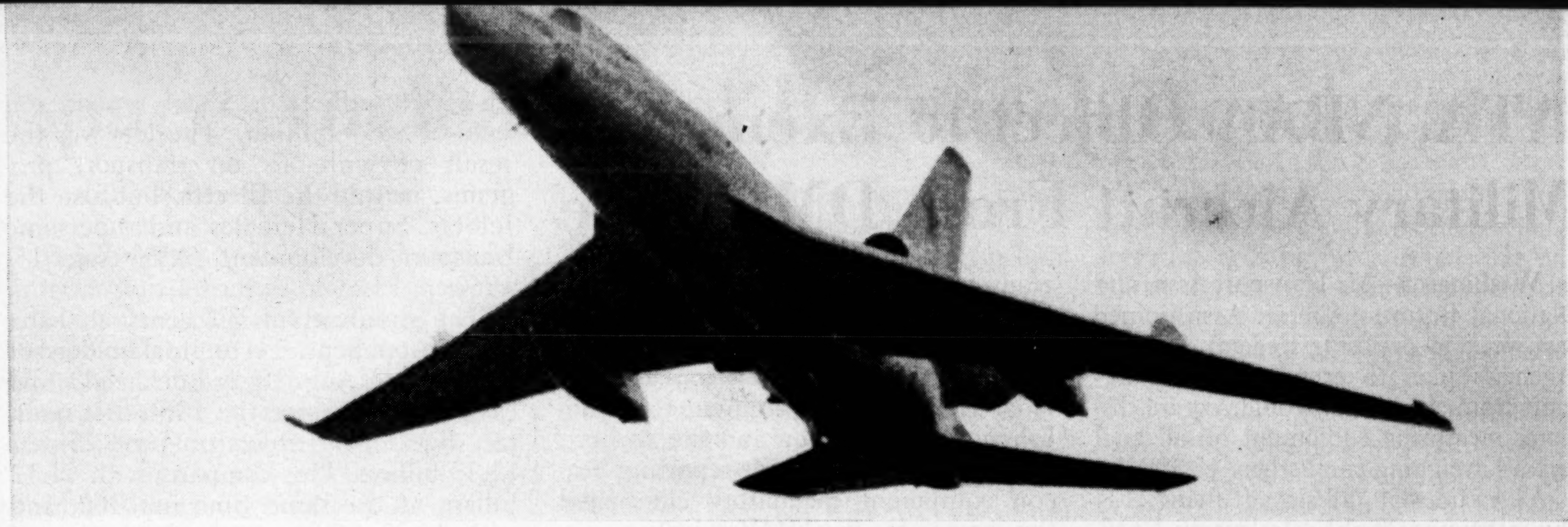
Tushino Not Altering British Air Policies

London—Display of Russia's air might at Tushino last month (AW July 17, p. 31) will have little immediate effect on Britain's deterrent efforts, Julian Amery, secretary of state (air), said in the House of Commons.

"Nothing seen at Tushino alters our view that the V-bomber force, with the successive improvements already planned in its offensive capability, will remain a valid deterrent for the rest of this decade," Amery said.

The improvements he mentioned are utilization of the Blue Steel standoff bomb and the Douglas Skybolt.

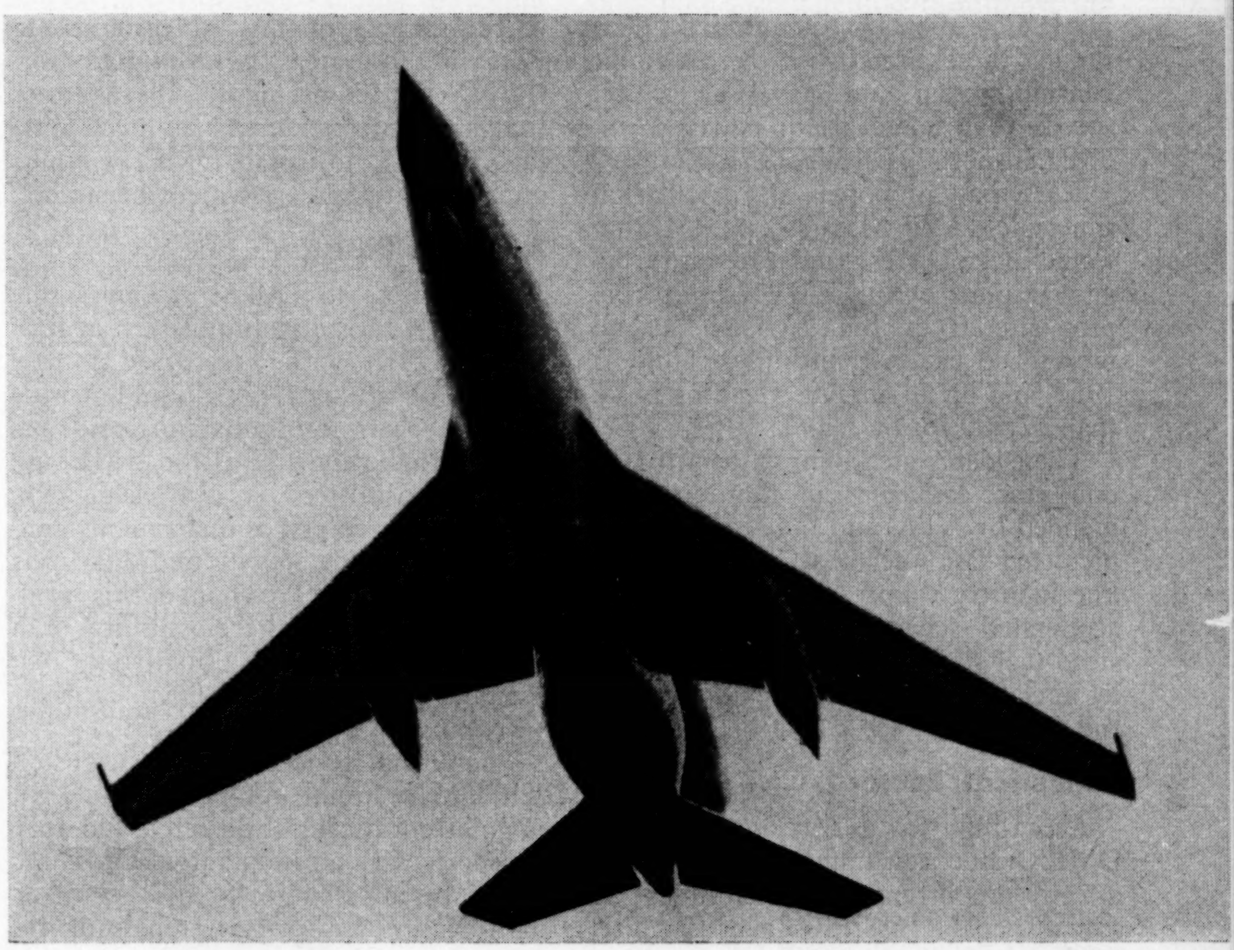
Turning to strategic airlift capability, Amery said the Royal Air Force will rely on the Short Belfast freighter, due for delivery in 1964, although consideration had been given to ordering the Lockheed C-130 as an interim aircraft. This approach has been dropped.

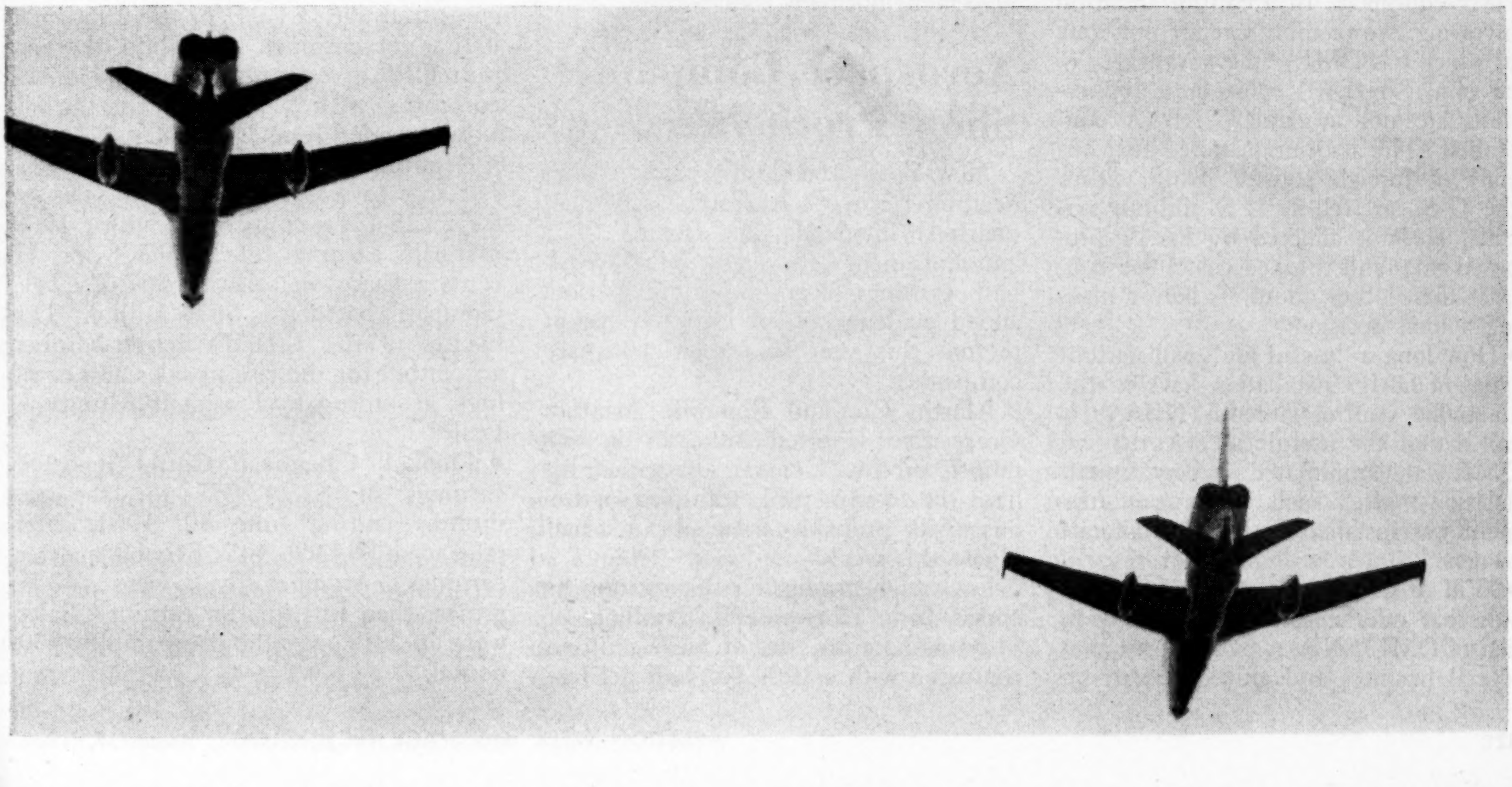


Nose of missile-carrying Beauty has fishmouth appearance unlike the more symmetrical configuration below.

New Photos Show Beauty Area Ruling, Nose Shapes

New photos of Russia's Beauty heavy bomber show extensive area rule treatment of fuselage. Bulge behind wing is added on, probably to compensate for landing gear blisters in wing. It then breaks back sharply to accommodate nacelles. Wing sweeps sharply at root, probably a device to extend the chord to delay root stall. Trailing edge, with flaps between blisters and fuselage and conventional ailerons outboard, is cranked slightly. Nose of missile carrying version (top) differs markedly from that of non-missile carrying airplane (right). Latter may be a reconnaissance version. Optical flats in bulge behind radome on the belly, and extending up fuselage could house forward looking and oblique cameras. Unusual feature is inward raked tips of the horizontal tail. Rear view (below) shows close set engine tailpipes, which lack fairing sometimes necessary because of flow problems. Wing fence near mid span contrasts with the advanced design of the airplane otherwise. Tip probes on wings are similar to those on tail surfaces of two new fighters seen at Tushino (AW July 24, p. 29), and on the Bounder heavy bomber.





ATA, NBAA Object to Exempting Military Aircraft From DME Rule

Washington—Air Transport Assn. and National Business Aircraft Assn. joined last week in opposing Federal Aviation Agency's plan to exempt military aircraft from a rule that would require distance measuring equipment on all civil aircraft weighing more than 12,500 lb.

ATA said that "all aircraft flying IFR [by instrument flight rules] using VOR or TACAN navigation aids should be required to have this equipment [DME] installed by appropriate dates." ATA thus took issue with FAA's stand that aircraft weighing less than 12,500 lb. need not be DME-equipped even though these aircraft use the air traffic control system and travel at greater speeds than some piston-powered airline transports.

FAA has proposed an installation timetable (AW May 29, p. 45) that would make DME mandatory on turbojet transports by July 1, 1962, on turboprop aircraft by Jan. 1, 1963, on all pressurized piston transports by July 1, 1963, and on all aircraft weighing more than 12,500 lb. by Jan. 1, 1964.

These dates are from six months to one year earlier than those recommended by ATA, and the airline group predicted last week that "the total airline industry simply cannot meet" the accelerated schedule. It proposed instead that its own target date for turbojet aircraft, Jan. 1, 1963, be adopted by the agency.

Numerical Factor

According to ATA and NBAA, DME's value as a traffic control tool is directly proportional to the number of aircraft capable of IFR flight that are DME-equipped. In a control situation involving two or more aircraft only one of which has DME, "the advantages to be gained by DME procedure applications are not available," NBAA contended. The association noted that aircraft of foreign registry flying within the U. S., as well as U. S. military aircraft, are not affected by FAA's proposed rule, and it asked that FAA consider these other questions before making a final decision:

- **How long a "useful life"** will current types of DME installation have in the air traffic control system? NBAA recalled that the usefulness of early civil DME was "annihilated by government decision" after such airborne equipment was installed by business aircraft owners.
- **Will FAA accept other** navigation aids that offer distance information in lieu of DME? NBAA pointed out that several business and airline aircraft already are equipped with Doppler navigation systems that show pilots their distance from an appropriate station.
- **Has FAA's renewed emphasis** on radar as a primary instrument for establishing IFR separation and the agency's proposal to make altitude-reporting beacon equipment mandatory eliminated the reasons for the DME rules?

ATA suggested that Jan. 1, 1964, or "a suitable future date" be set as the deadline for requiring lightweight DME on all IFR aircraft. It also urged that Hawaiian and Alaskan carriers, because of the scarcity of TACAN ground stations in those areas, be exempted from the DME requirement. It suggested that helicopter operators be given until Jan. 1, 1965, to install DME or equipment "of at least equivalent accuracy."

Airlines' Position

According to ATA, airlines are "strongly and unanimously" against tuning DME with a separate control head. One tuning action should provide the pilot with both distance and azimuth information. Thus the DME and VOR transmitters at the same site would be paired just as instrument landing system glide slopes and localizers now are paired. To change this principle would open the possibility of a pilot's getting his direction from one station and his distance from another, ATA pointed out.

The airline association also suggested that DME should not be made a "go, no-go" item for flight dispatch and that transports with an inoperative DME set should be allowed to fly to the major maintenance base where repair or replacement normally is made.

Aerospace Companies Show Profit Increase

New York—Lockheed Aircraft Corp's decision last week to resume a 30-cent quarterly dividend, plus Boeing Co.'s announcement of a slight gain in first-half earnings over the 1960 period, added evidence of an improved profit picture this year for major aerospace companies.

Martin Co. and Republic Aviation Corp. also reported increases in six-month profits. General Dynamics, hit hard by commercial transport write-offs, will probably issue its first-half report this week.

Lockheed earnings for the six months ended June 25 were $9.2 million or $1.24 a share on sales of $679 million, compared with a 1960 first-half net loss of $55.4 million or $7.64 a share on sales of $657 million. The loss was the result of write-offs on transport programs, mainly the Electra, but also the JetStar, Super Hercules and supersonic transport development (AW Aug. 15, 1960, p. 51).

The dividend of 30 cents a share, payable on Sept. 11 to stockholders of record as of Aug. 18, is Lockheed's first cash dividend since the 1960 first quarter. Backlog of orders on June 25 was $1.32 billion. This compares with $1.12 billion at the same time in 1960, and with $1.22 billion at the beginning of this year.

Six-month earnings reports from other aerospace companies:

- **Boeing Co.** earned $16,174,546 or $2.03 a share on sales of $823,629,052 compared with 1960 first-half earnings of $10,260,056 or $1.29 a share on sales of $817,463,295. The company declared a regular 40-cents-a-share quarterly dividend. President William M. Allen said increased B-52 and Bomarc deliveries during the second quarter helped boost earnings. Costs of the 727 jet transport and the Boeing Vertol 107 helicopter programs are being charged against earnings as they are incurred. Backlog of unfilled orders was $2.196 billion on June 30, including $794 million related to military aircraft programs, $414 million for missile and space projects, and $988 million for commercial programs. Backlog at the end of first quarter was $2.209 billion.
- **Martin Co.** sales for the first half of 1961 were $408,193,230 compared with $301,985,702 for the first six months of 1960. In the second quarter, Martin liquidated its investment in stock of General Precision Equipment Corp. and made a before-taxes profit of $5,290,000. Martin's per-share earnings for the first half, excluding this profit from GPE stock, were $1.56 compared with $1.24 for the 1960 first half. Net earnings, including the net from GPE divestiture, were $13,538,418 compared with $7,647,710 for the six months ended June 30, 1960.
- **Republic Aviation Corp.** earned $5,187,283 or $3.59 a share on sales of $172,228,431 compared with 1960 first-half earnings of $839,378 or 59 cents a share on sales of $67,659,241. Company backlog is $613 million. Deliveries of the F-105D fighter-bomber accounted for the rise in sales and earnings, according to President Mundy I. Peale.
- **Thiokol Chemical Corp.** reported earnings of $2,242,755 for the six months ending June 30, 1961. Net sales were $84,996,405. Second quarter earnings, significantly, were 15% greater than first quarter earnings. Sales were up 29% over the comparable 1960 period.

Space Nuclear Test Research Accelerated

By Katherine Johnsen

Washington—Vela Hotel research program for detection of nuclear explosions in outer space—unhampered by the current voluntary testing moratorium—has been accelerated and is now moving forward as fast as technically feasible, according to testimony presented to the Joint Congressional Committee on Atomic Energy.

Air Force Maj. John A. Poulson, chief of the Vela Hotel Branch of Advanced Research Projects Agency, reported that underground detonations may be required in a later phase of the program—several years away—to develop detection devices for shielding and other countermeasures that could be used to cover outer space explosions.

Dr. B. P. Leonard, a space program director at Aerospace Corp. and a member of Defense Department's Ad Hoc Group on Detection of Nuclear Detonations, told the committee that "there is no question that both the U. S. and the USSR have the capability" to perform nuclear weapon tests in space. "While the amount of data obtained would be limited," he commented, "it nevertheless would be highly significant in determining the performance of the device."

The Vela Hotel research and development program, scheduled through 1964, is aimed at laying the groundwork for an operational detection system of approximately six satellites (AW Nov. 14, p. 29).

Detectors on Ranger

A major step in the current phase—directed at detection of natural phenomena in outer space—will be the mounting of two X-ray detectors on National Aeronautics and Space Administration's first Ranger probe.

The detectors will be pointed directly at the sun.

The next major experiment will be a package of two X-ray detectors and two gamma-ray detectors to be launched by an Air Force Blue Scout, Jr., rocket this fall.

Los Alamos Scientific Laboratory and Sandia Corp. are now in the process of flying full-scale instrument packages simulating a detection satellite suspended from balloons at about 120,000 ft.

The packages contain 12 X-ray or, interchangeably, 12 gamma-ray detectors.

The final phase of the experimental program will consist of five launches of two experimental spacecraft each from the Atlantic Missile Range in "a few years." Design on the detectors for the satellite will be frozen Sept. 1. They will orbit at an altitude of 50,000 to 75,000 naut. mi. and have a useful life of about six months.

Each satellite is to be equipped with 10 X-ray detectors, six gamma-ray detectors, a neutron detector and 10 guard counters, and appropriate electronic logics.

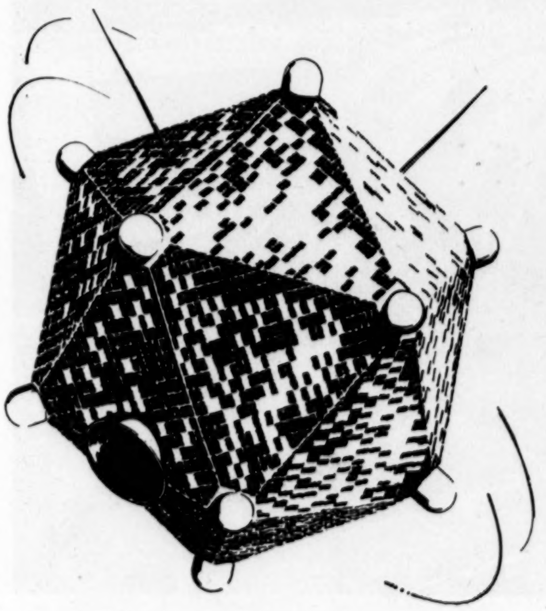
The satellites will be powered with solar cells.

Solar Confusion

The anticipated advantage of simultaneously launching two spacecraft, according to Dr. Leonard, is that localized cosmic ray "showers" would probably cause signals in only one satellite, but radiation emanations from the sun could cause signals in both satellites. Since correlated alarms in more than one satellite would be interpreted as a weapon test, Dr. Leonard observed, "a serious situation" would develop, requiring research to differentiate between sun and nuclear phenomena.

By establishing a time correlation between several detectors in one satellite and between two or more satellites, Maj. Poulson said that the "false alarm" rate can be reduced as low as one per hundred years—on the basis of statistical theory.

According to estimates of detection capability, he said, to escape detection, a test ban violator would be forced to test an unshielded device more than 100 million mi. from earth—"a formidable undertaking at least for the immediate future."



VELA HOTEL satellite will detect nuclear explosions in outer space—50,000 to 75,000 naut. mi. from the earth. The first of five launches of two satellites each is scheduled for 1963-64. X-ray detectors are mounted at the outer surface of the satellites to form a system for monitoring space in all directions. Gamma ray and neutron detectors will be mounted internally.

If Vela Hotel is carried beyond 1964, Maj. Poulson said, radio frequency pulse detection will be investigated. He anticipated that this would facilitate the detection of shielded explosions, commenting, "the more shielding the better radio frequency pulse."

The Geneva System of Control—the basis for U. S.-USSR negotiations on a test ban agreement—would involve five to six earth satellites in orbit at altitudes above 20,000 mi. and instrumented to detect gamma rays, neutrons and X-rays from space nuclear explosions. It would also include earth-based control posts equipped for space detection and possibly four solar satellites to improve detection of explosions behind the sun and the moon or to make concealment of space explosions more difficult.

Detection Capability

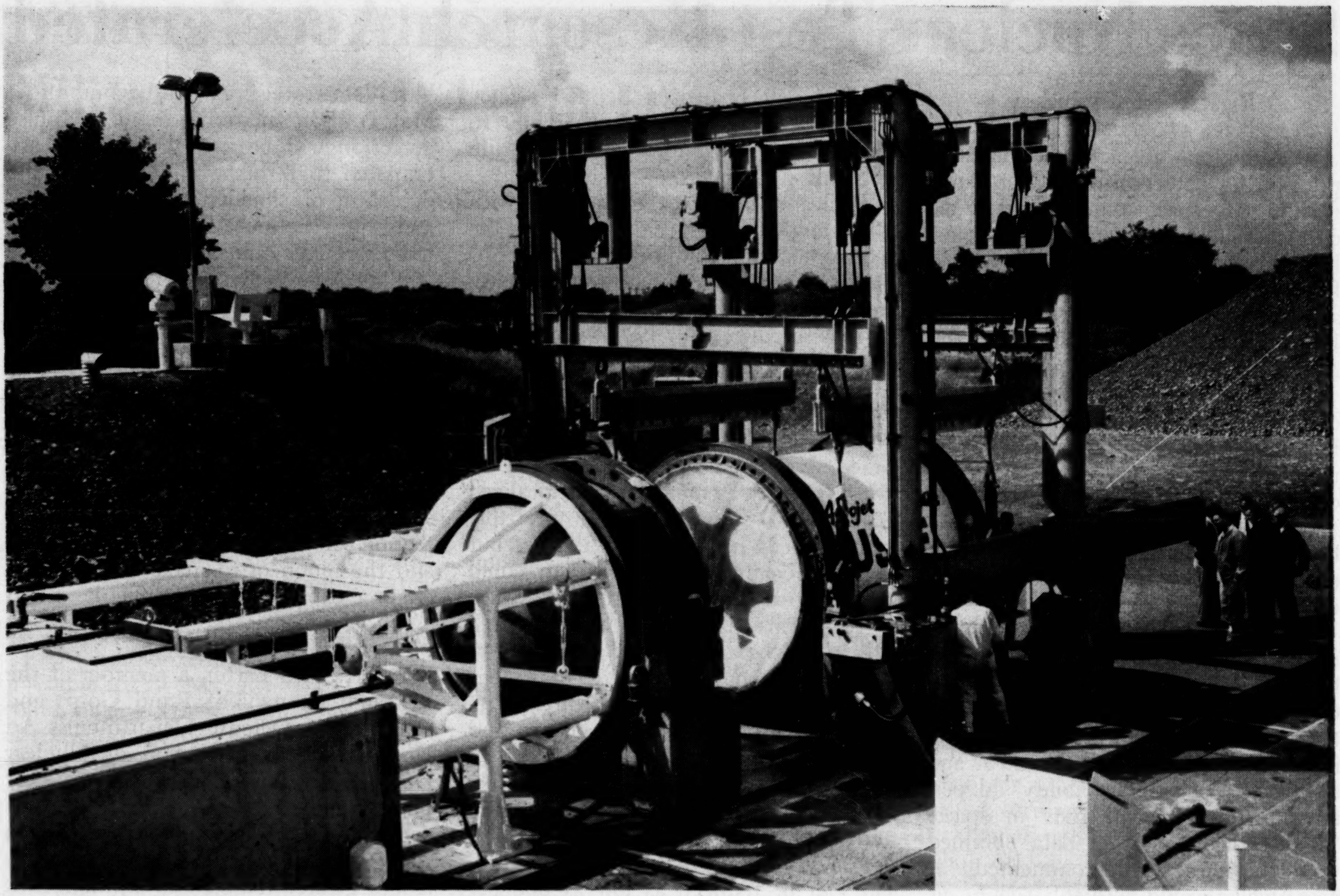
Dr. Richard Latter, a member of the Research Council of Rand Corp. and chairman of Defense Department's Ad Hoc Group on Detection of Nuclear Detonations, told the committee that this system has "a good probability" of detecting unshielded nuclear explosions above approximately 10 kilotons at distances greater than a few million to a few tens of millions of miles. Shielded explosions up to hundreds of kilotons could not be detected at these same distances, he added.

Similar signals from natural events may make it impossible to identify nuclear explosions in space, Dr. Latter noted.

Commenting that the signals from nuclear detonations "are reasonably well-understood," Dr. Latter explained:

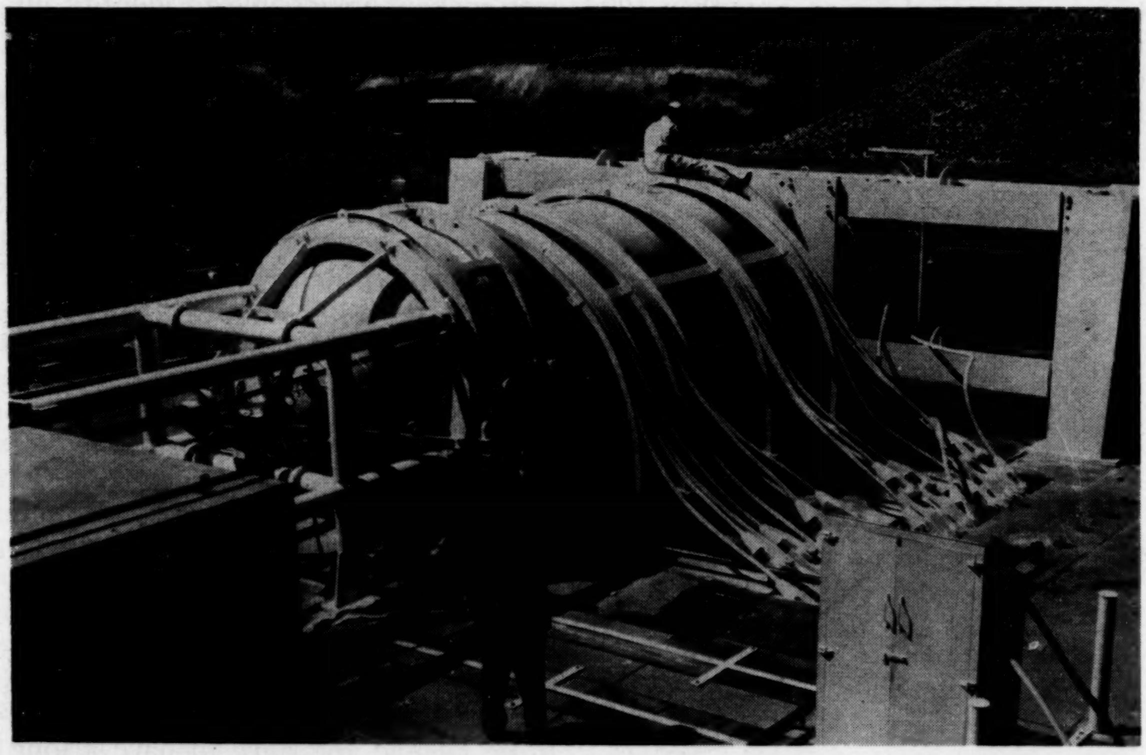
"The difficulties in the space detection problem come when we attempt to design the means by which the control system is to detect these explosion signals. . . . We are at present quite ignorant concerning the natural background noise which obscures the explosion signals and which might produce signals similar to nuclear explosions." Experiments to determine the relevant space backgrounds, requiring the launching of instrumented satellites, he emphasized, are "difficult and costly" and the degree of success "is quite uncertain.

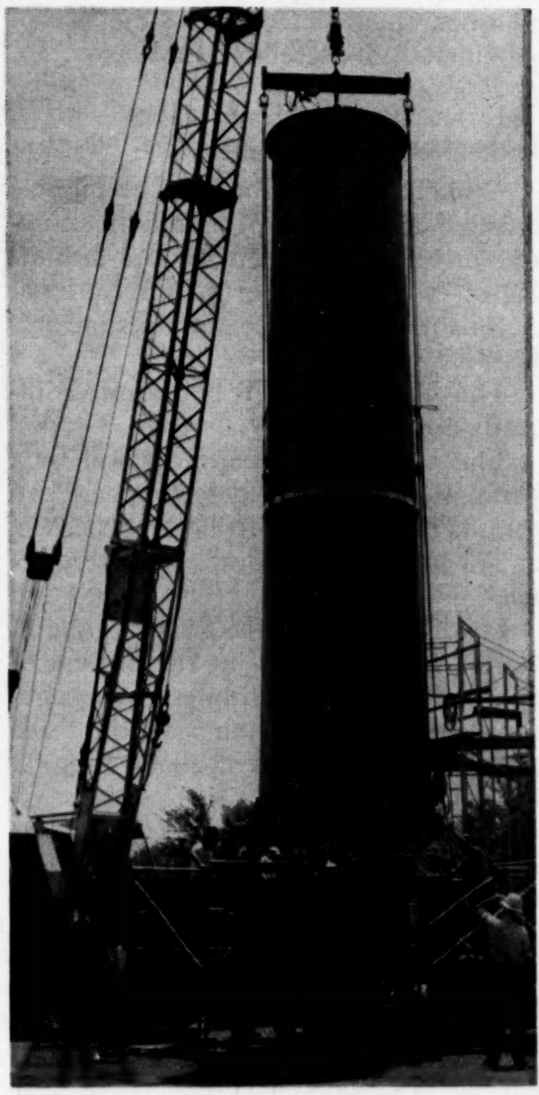
"The satellite instrumentation will have to be reliable and have to have a long life—otherwise the cost of the system could be prohibitive. To achieve a long instrument life is a fundamental problem of our entire space program. Simplicity is an essential prerequisite. Simplicity, however, would lead to a decrease in detection capability. A compromise will be necessary," Dr. Latter said.



Travel-lift moves center segment of Aerojet-General solid fuel rocket motor into position to mate with forward segment prior to firing.

Aerojet-General, UTC Test Solid Rocket Components





Mated segments of Aerojet-General motor (above) are prepared for firing at Sacramento, Calif. facility. Sections can be mated in less than five minutes under field conditions, company claims. Motor generated nearly 500,000 lb. thrust during 40 sec. firing. Conical two-segment steel case for United Technology Corp.'s 500,000-lb. thrust solid propellant P-2 motor (right) is set up for hydro-test at Pratt & Whitney Aircraft's East Hartford, Conn., facility where it was constructed. Base diameter is 98 in., tapering to 80 in. diameter at bottom of top segment. Motor, 40 ft. long, is expected to burn about 80 sec. during firing tests scheduled tentatively for mid-October. Mass ratio of the motor will be approximately 0.90.

Taped Tracking Data To Guide Zeus Shots

Pt. Mugu, Calif.—Nike Zeus antimissile missile firings scheduled to begin here last Saturday will parallel a series of dry runs in which the target intercept computer will be fed the taped tracking data of USAF ICBM firings from Cape Canaveral. Data was collected by a Zeus target track radar at Ascension Island.

There is no actual target track radar in the Pt. Mugu installation and the command guidance system will be exercised without an actual target until test activities move to Kwajalein in the Marshall Islands. The first Kwajalein launch is scheduled for March (AW Apr. 17, p. 71) but since the Pt. Mugu tests are starting several weeks ahead of original schedules, the Kwajalein tests may also be moved up.

The first targets will be short-range Speedball rockets launched from the island of Roi Namur. Climax of the development program will be tests against Atlas missiles launched from Vandenberg AFB, Calif.

Eastern Reorganizes Its Top Management

Eastern Air Lines has realigned its top management group to permit direct executive supervision of all of the company's operations.

Under the new plan, now in effect, four new posts of executive vice president have been created to provide a new level of executive authority directly responsible to Eastern's President, Malcolm A. MacIntyre. The company's board of directors also elected four new vice presidents to complete the reorganizational plan. Capt. Eddie Rickenbacker remains chairman of the board.

First major management division will be headed by Robert L. Turner, who has been elected to the new position of executive vice president-transportation services, as well as to the board of directors. Reporting directly to Turner will be newly elected Frank Sharpe, vice president-customer services, Robert Springer, vice president-flight operations; Ambrose L. Chabot, vice president-aircraft maintenance, and Don C. McRae, assistant vice president and director of communications.

Maurice Lethbridge, who has been elected executive vice president-staff services, will head all activities pertaining to schedules, routes, market and economic research, aircraft engineering, properties and related community relations. This second management division will include Robert S. Lipp, elected vice president-market and economic research, and Warren R. Winn, Jr., named vice president-schedules and planning.

A third management division is headed by Capt. John H. Halliburton, executive vice president-administrative services. This division will conduct all activities concerning operating bases, airports, medical services, security and standards of performance. Joseph H. Brock has been elected vice president-base administration to assist Halliburton.

No officer has yet been named to serve as executive vice president-finance in the fourth management division.

Simulated Snap Fuel Tested in Re-entry

Washington—Two simulated, nonradioactive nuclear power generator fuel cores were launched 5,000 mi. down the Atlantic Missile Range aboard an Atlas-E missile last week in the first of a series of five such flights to be conducted this year by the Air Force for the Atomic Energy Commission.

The flight tests are to determine the temperature and heating rates of nuclear-powered devices during re-entry from orbit and are expected to prove that Space Nuclear Auxiliary Power (Snap) units will burn up harmlessly at this point.

Instead of isotopic cores, one cylinder carried a tube of sodium and the other contained potassium. Placed in lead/silver alloy capsules, the capsules—along with a telemetry capsule—were carried in a 3.5-ft.-long, 100-lb. package mounted externally on the General Dynamics Atlas.

At an altitude of about 500 mi., the package was jettisoned from the Atlas and placed on a ballistic trajectory. Prior to re-entry, the package itself was split open and the three capsules ejected. Sensors along the titanium walls of the telemetry capsule monitored the temperature rise, and this data was transmitted to ground stations.

The core containers ablated under the high re-entry temperature and complete disintegration was marked by the ignition of the sodium and potassium.

News Digest

Space Technology Laboratories will be given responsibility for systems engineering and technical direction of National Aeronautics and Space Administration's experimental active repeater communications satellite program known as Project Relay under recently awarded contract from the space agency. Radio Corp. of America has the prime contract for developing Relay satellites (AW May 22, p. 27).

Ranger space probe, originally scheduled for launch on July 27-28, has now been postponed until late this month, when the sun, earth and moon are again in favorable relative positions. Technical difficulties had prevented NASA from launching the vehicle within the 8-day astronomical "window."

Airlines using London's international airports will be charged for technical services such as air traffic and en route control (AW Apr. 17, p. 45), in addition to landing fees now paid, when the new authority takes over probably in 1963-64 (see p. 43), according to Minister of Aviation Peter Thorneycroft.

Finn J. Larsen, Minneapolis-Honeywell vice president in charge of research, has been named assistant Army secretary for research and development.

Three Soviet cities will be visited by a four-place Cessna 172 Skyhawk business plane, which will be a part of an exhibit sponsored by the U. S. Information Agency aimed at showing Russians how Americans travel by air, land and sea. Skyhawk will spend 21 days each at Moscow, Stalingrad and Odessa, beginning in mid-September. Tour ends in mid-January.

USAF Electronics Systems Division will solicit industry proposals for its nuclear definition and reporting system (477L). Letters of interest must be filed by Aug. 14 with ESD Commander, Hanscom Field, Bedford, Mass.

Gerald L. Phillippe became president of General Electric and C. W. LaPierre became executive vice president last week. Phillippe, former GE comptroller, replaces Ralph J. Cordiner, who was acting president and who will remain as chairman of the board and chief executive officer. LaPierre, former vice president and group executive for electronic and flight systems group, moves into a newly created position.

Strike notice set for midnight Aug. 7, was served by the Engineers and Scientists Guild on Lockheed-California Co. The ESG, representing 2,700 Lockheed employes, had asked for pay raises ranging from 5 to 8% effective at the expiration of their contract.

First batch of Dassault Mirage III supersonic fighters has been delivered to the French air force at Dijon.

Army evaluation team will look over the first Bell HU-1D Iroquois turbine-powered helicopter in the next few weeks at the company's Hurst, Tex., plant and probably will be given a flight demonstration of its capabilities. The HU-1D is an enlarged cabin version of the HU-1 series.

Minor Issues Used to Block New Fares

Analysis of IATA meeting shows prospects bleak for new promotional rates in the foreseeable future.

By L. L. Doty

Washington—Analysis of the International Air Transport Assn. fare conference held in London last month reveals that international flag carriers are so widely split on superficial rate issues that prospects are bleak for any new promotional fares being introduced in the foreseeable future.

The two-day meeting (AW July 24, p. 41), which was called to determine promotional rates that would attract new traffic to offset swelling seat capacity, collapsed in complete deadlock. Failure did not necessarily result from an inability to see eye-to-eye on major issues, although a group resisting any fare decreases does exist. It stemmed primarily from dissension over minor points and trifling conditions attached to various proposals.

The meeting, attended by 17 North Atlantic airlines, opened in an atmosphere of general backing of group fares—a system of granting discounts to groups traveling together on scheduled airline services. It bogged down amid disputes over the size of the groups, times of the year discounts should apply, length of time tickets should be valid and conditions which should apply to the travel.

Delegates expressed support of an excursion rate proposed by Scandinavian Airlines System. But again, widespread argument over relatively minor details of the plan arose to kill the proposal, although El Al did hold out against the adoption of any new excursion plan.

Traffic Stimulants Needed

Most airline officials feel that there is a strong need for lower fares on the North Atlantic as the only means of restoring dwindling load factors to a profitable level (AW July 31, p. 38). Representatives at the London meeting largely agreed with this view and attended the meeting with a strong hope that agreement on promotional fares could be reached.

The great majority of carriers wanted a group fare structure, and many were willing to, and did, compromise on conditions unfavorable to their interests in moves to reach agreement on this rate. At the time the meeting convened, there were no more than four carriers opposed to the group fare principle.

Of these, SAS, while not voicing violent opposition to group fares during the meeting, staunchly pushed a 23-day excursion fare that would drop the New York-London round-trip rate to about $300. To prevent diversion of business traffic from standard rates to the proposed fare, SAS proposed that the return trip be started not less than 14 days after original departure—a condition similar to that included in the proposed TWA transcontinental excursion fare (AW July 24, p. 40).

Air-India International was opposed to group rates and said the Indian government favored promotional fares. British Overseas Airways Corp. took a firm stand against group rates but showed a willingness to support tour basing fares.

Iberia lent very little support to the group rating system because of the diversionary effect it would have on other traffic. It said that the introduction of an individual promotional rate is essential to the development of new traffic and that it would accept a group rate only if excursion rates were expanded.

Lufthansa was basically opposed to group travel discounts but showed a willingness to accept the system if it were applied to off-season periods. Pakistan International Airlines, a newcomer to the North Atlantic route, took no position on group rates but said it was inclined toward the excursion type fare with an extension of the time validity of such a fare.

Trans-Canada Air Lines and TWA opened the discussions by opposing group rates that would apply throughout the year and suggesting that such rates should not be effective over weekends during peak seasons. Eight airlines backed this view, while three carriers—Alitalia, Lufthansa and Swissair—supported an all-year application of the group rate except during the summer peak period.

BOAC underscored its rigid resistance to the group rate concept, while Air-India took no stand during the early discussions because of its basic dislike of the group approach.

On the question of how large or small groups should be to qualify for a group rate, delegates scattered in every direction in disagreement. Ten carriers refused to accept a proposal that the minimum size of a group should be held to approximately 30 persons. Swissair was for a minimum of 20. KLM proposed a minimum of 20 for groups originating in Europe, a minimum of 30 for groups originating in the U. S. Aerlinte Eirann TTA (Irish Air Lines) wanted a 40 minimum for U. S. travelers, 25 for European travelers.

Details Disputed

Six carriers then said they supported a lower minimum for groups originating in Europe than in the U. S. but they were opposed by Air France, BOAC, Pan American and TWA. Pan American then suggested two group fares; groups up to 50 passengers would be granted a greater discount than groups up to 25 would receive.

Trans-Canada backed this position but then Iberia said it preferred to hold any groups to 40 and KLM said that groups larger than 30 would create ground transportation problems. Six airlines liked the two-size formula, but TWA and Air France charged that it would cause too complicated a tariff.

Carriers ran into similar disputes over the conditions which should be applied to group rates. Irish Air Lines, for example, said it felt that groups should travel together to and from the gateway but, beyond this stage of the trip, they should be allowed to break up and move about individually. Pan American held that passengers should leave and return together and should be required to make at least two stops in Europe or the U. S.

Seven carriers favored the condition that groups should travel together at all times. Five carriers argued that group members should be permitted to move individually except during the outbound and inbound legs of the trips.

On the subject of the amount of discount that should be granted groups, seven airlines were willing to accept a TWA proposal for a minimum group of 30 at a reduction of 33⅓% under the normal round-trip fare. Seven were against the proposal.

Other proposals were made during the discussions, and when the final votes were tabulated, it was evident that the carriers came as close to unanimity on the discount issue than on any other major point raised during the course of the meeting. Except for two carriers strongly opposed to the group fare principle, only Air France and TWA were unable to accept a proposed minimum group of 30 at a 35% discount.

On the second day of the meeting, SAS offered its 23-day North Atlantic excursion fare, to apply throughout the year, at a New York-Copenhagen rate of $350 round trip. The rate, which later was amended to require a minimum stay of 14 days, presumably was introduced by SAS to counter the low fares offered by the non-IATA carrier, Loftleider, the Icelandic airline.

Air-India said it would accept the proposal if time validity were extended to 35 days for trips into its area. Swissair asked for certain modifications of the rate proposal. But on the first voting, the SAS rate was opposed by 10 airlines: Irish Air Lines, Air France, Alitalia, BOAC, El Al, KLM, Sabena, Lufthansa, Pan American and TWA.

From this point on, the carriers again moved apart along their separate ways. Swissair wanted two excursion fares—one for winter and one for summer. Trans-Canada proposed such a rate—$350 New York-London on-season with a 17-day minimum and $300 off-season with a 23-day maximum but no minimum. Six carriers voted for this, but 10 carriers found this unacceptable.

Of the 10, eight wanted no change in the present fare level. Eight were willing to consider a change in the present 17-day time period of the current excursion rate, but three airlines—KLM, Pan American and TWA—offered stiff resistance against this suggestion.

Big holdout against the excursion rate was El Al. It wanted no revisions in the present 17-day rate and even went so far as to say it would like to see this rate eliminated. El Al said the proposed rate would only create diversion; Pan American agreed.

BOAC wanted no change in the present excursion rate. Alitalia stated that any new excursion rate during peak seasons was unacceptable. Air France held that the industry is too far into the current peak season to make any changes in the present excursion rate.

Eleven airlines favored an extension of the present excursion fare to a longer period of time—it is now effective only between Oct. 1 and Mar. 31. But counter-proposals, designed to bring about some agreement on the time element, failed to make any headway, although El Al held informal discussions with several carriers in hopes of reaching a compromise, and the excursion fare proposal went by the board.

During discussions on tour basing fares for all-inclusive tours, the carriers were unable to achieve any more than they had on earlier subjects. BOAC and KLM each outlined detailed proposals for tour basing fares.

Trunklines Adopting Youth Fare Proposed by American to Fill Seats

Washington—Domestic trunklines moved last week to adopt the youth fare plan initially proposed by American Airlines as a possible solution to the growing overcapacity problem plaguing U.S. carriers.

By late last week, at least seven trunklines had filed tariffs scheduled to go into effect the end of this month on a six-month trial basis, including American, TWA, Braniff Airways, Delta Air Lines, Continental Airlines, United Air Lines and Western Air Lines.

Earlier, Bonanza Air Lines proposed a similar youth fare, and it was to have become effective July 20. Under Bonanza's plan, passengers would have to be between the ages of 12 and 21 and purchase a $2.00 identification card good for one year before they could travel at a 50% reduction in first-class fare. Bonanza says the Civil Aeronautics Board has delayed the effective date of its youth fare until Aug. 20 and raised the baggage limitation from 20 to 40 lb. Other local airlines are expected to adopt the youth fare plan.

TWA proposed a promotional excursion fare plan last month to fill its growing seat capacity (AW July 24, p. 40). TWA's plan calls for round-trip transcontinental excursion fares of $198 for jet and $178 for piston aircraft effective Aug. 18-Dec. 15. American immediately filed a similar fare, stating it is opposed to the idea but filed to remain competitive.

United Air Lines also filed an excursion tariff, but last week the carrier asked CAB to suspend and investigate the excursion fares on the grounds that, using TWA's own diversion figures, United stands to lose $2.6 million during the trial period. United claims that it would have to promote 13,000 new transcontinental passengers to cover the loss. Northwest joined United in asking for suspension and investigation of the fare.

Under the youth fare plan proposed by American, passengers between the ages of 12 and 22 could travel at half the first-class fare on any of the airlines' scheduled flights if space were available. A definite reservation could be made for space still unsold within three hours of flight departure, or a youth-fare passenger could simply board the aircraft on a standby basis. He would be seated in the coach section first. If more space were needed, the passengers would be seated in the first-class section.

Older passengers within the 12-22 category would be required to show identification, such as a driver's license, to prove eligibility for the fare discount.

The fares are to apply on all the carriers' domestic routes, except United Air Lines' Hawaii flights. American said the fares will not apply on nonstop flights from Mexico due to international complications. Youth fares would not apply on the international systems of other trunklines adopting the plan, except for flights to Canada.

G. Marion Sadler, American vice president and general manager, said that American adopted the plan after a long study to find a way to sell unused capacity without diverting existing coach traffic. He said American was opposed to fares that divert existing traffic from one fare category to another or from one airline to another.

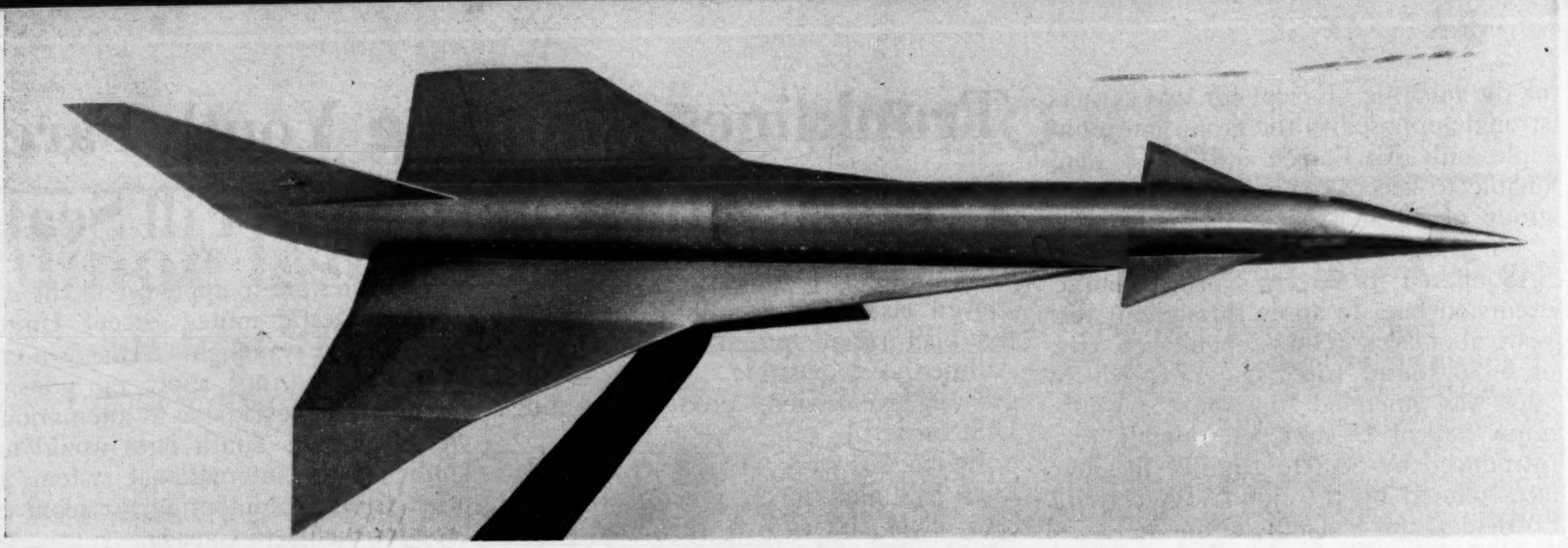
Market Potential

Sadler said American's studies indicated that 15% of the nation's population is between the ages of 12 and 22, yet only 3% of the airline's present passengers fall into this category. The armed forces account for about 500,000 potential youth-fare passengers. If this market can be persuaded to buy what Sadler describes as "the waste product"— capacity above existing load factors—then American could make money at existing coach fare levels.

American says its advertising campaign will enlist the cooperation of the travel industry, overseas airlines and agencies participating in the Visit U.S.A. program. The youth fares may help encourage foreign students to visit the U.S. by bringing air travel in this country within their financial reach. In the Soviet Union, Aeroflot offers a series of discounts for tourist, sports and public groups with the highest discount—25% on a round-trip fare—reserved for students.

American says its youth fare plan will not be unjust or discriminatory because it represents an effort to sell space that is going to waste anyway. The carrier said that it rejected the "air bus" service operated by Eastern Air Lines between certain points as a means of selling unused capacity. Sadler said he doesn't believe the air bus plan offers a solution because it is still unproven and may not pay for diversion from regular flights. He also observed that air bus is expensive because of having to maintain backup equipment and crews and because it involves older equipment.

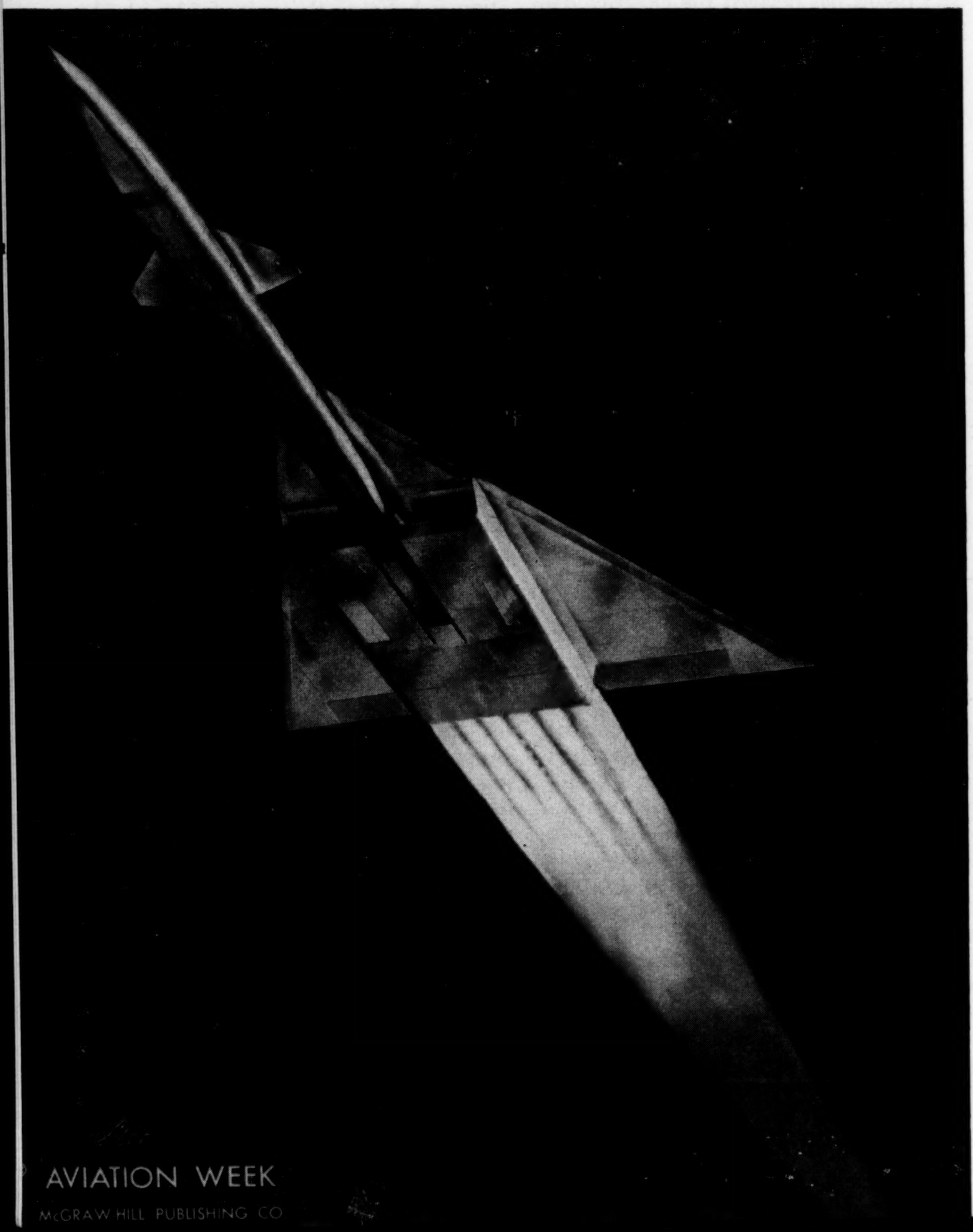
Fares offered under the youth fare plan include New York-Los Angeles or San Francisco, $85.75; New York-Chicago, $25.10; New York-Boston, $7.50; Chicago-Phoenix, $52.10; Baltimore-Los Angeles, $80.65.



DOUGLAS AIRCRAFT CO. model of a supersonic transport design shows the double delta wing planform with tips that droop for directional stability at Mach 3 cruise. Length of the proposed aircraft would be 200 ft., wingspan 100 ft. with the wingtips extended for subsonic flight. Under study for four years, the aircraft would cruise at 70,000 ft., operate at seat mile costs comparable to present jet transports and be capable of using existing airports (AW July 24, p. 23).

Senate Votes Mach 3 Transport Funds

AVIATION WEEK ARTIST'S rendering shows current thinking of North American Aviation design team which visualizes a supersonic transport configuration derived from B-70 geometry but using aerodynamic advances available since the Mach 3 bomber was planned. Note rearranged engine housing configuration and changed wing location.



Washington—Development of a supersonic transport under a joint government-industry program neared final congressional approval last week when the Senate voted $12 million in research funds following an attempt to kill the program.

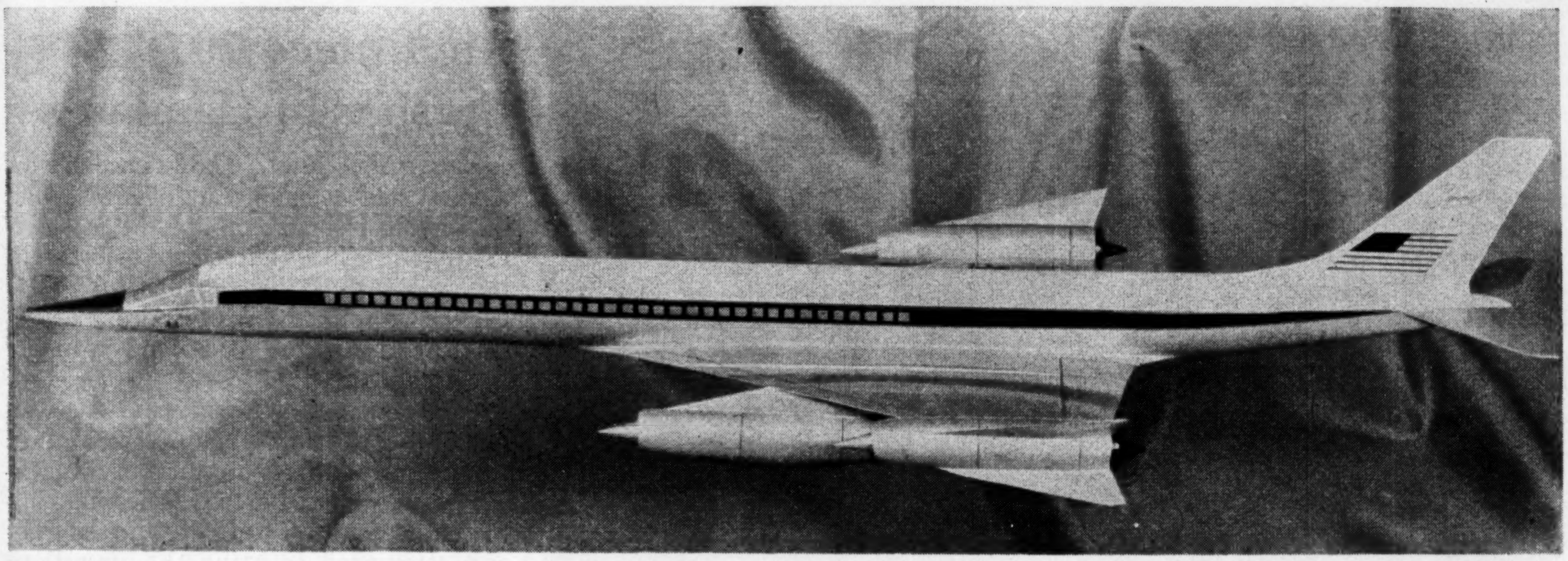
Supporters view development of an economical Mach 3 transport as a major step toward the goal of capturing a larger share of the world market for U. S. aircraft manufacturers. The development effort could cost as much as $700 million.

Federal Aviation Agency Administrator Najeeb E. Halaby conceded in testimony before Congress the possibility that Soviet Russia or some other nation might beat the U. S. to development of a supersonic transport, but he emphasized that the U. S. wants the first economically competitive version, whether or not it is the first to fly. Russia has indicated it also is taking a fresh design approach to the supersonic transport, rather than converting a military aircraft (AW July 31, p. 36).

The Kennedy Administration has requested $12 million for Fiscal 1962 to support industry research on the transport. The House voted to appropriate $10 million, while the Senate voted for the $12 million last week after defeating on a 35-35 tie vote an amendment by Sen. Stuart Symington (D.-Mo.) to eliminate the $12 million previously approved by the Senate appropriations committee.

Symington's Protest

"I would not protest this item [for the $12 million]," Sen. Symington said in offering the amendment on the floor, "if it was not for the fact that I do not see how the government could refuse to acquiesce, which it is doing, in the development of a weapon system for the B-70, a military Mach 3 aircraft, at the same time it subsidizes for industry a



CONVAIR supersonic transport concept has delta wing with tip-mounted outboard engines. Unlike B-58, it has horizontal stabilizer.

comparable commercial Mach 3 aircraft."

Final decision on the funds to be appropriated for the supersonic transport was left to House-Senate conferees working out a compromise independent offices money bill, which contains the funds for FAA and the National Aeronautics and Space Administration. In both the House and Senate-passed bills, NASA is slated to get $8.5 million for supersonic transport research (see p. 77).

The $12 million requested by President Kennedy for Fiscal 1962 for FAA to expand research on the supersonic transport is to be followed by another request for about $38 million to continue this work in Fiscal 1963. At the end of the two years, the government will decide whether to subsidize further the development program or leave the program entirely up to private aircraft companies.

Halaby, as head of the Federal Aviation Agency, will be the principal administrator of the supersonic transport project since most of the research money will go to his agency. He told the House Science and Astronautics Committee last week that the research program will mark the first time the federal government and private industry jointly developed a commercial airplane.

Subsidy Justified

He said the federal subsidy is justified since the aircraft industry cannot afford to develop the supersonic transport on its own. Yet, he argued, development of the transport is in "the national interest" since it would help stimulate a key segment of the economy.

"Our goal," Halaby said, "is the production in the U. S. of the world's first economically competitive supersonic transport. Our aim is the best transport. It might not be the first, but we want it to be the best." He said U. S. commercial aircraft manufacturers will be "in rough shape in the world market" if Russia produces such a transport first, but he fended off suggestions by committee members that more research money be appropriated to hasten U. S. development work.

Halaby said that under current money requests, "we're pursuing a sensible program that is technically feasible and will pay off in the end."

B-70 Limitations

Both Halaby and Ira H. Abbott, director of NASA's Office of Advanced Research Programs, said the B-70 development program would not yield all the answers to technical problems connected with a supersonic transport airplane. Abbott said the transport's development "will require the evolution of a new rationale for government support." However, in addition to subsidizing private research on the supersonic transport, Abbott said NASA soon hopes to use the B-58 bomber in flight "to study many of the stability, control and piloting problems that supersonic aircraft would encounter in transport operations."

NASA, USAF Explore Aviation's Future

Washington—National Aeronautics and Space Administration and Air Force officials explored the future of manned aircraft last week, predicting an era which will make all previous aeronautical progress look slow in comparison.

"Far from believing that aeronautics has achieved adulthood," Ira H. Abbott, NASA director of the Office of Advanced Research Programs, said "We believe it stands on the threshold of its most rapid advancement . . . We are convinced of the continuing importance of aviation."

Abbott said that although coming aeronautical advances "will make all previous aeronautical progress seem slow," NASA until this year has had research money about equal to that spent in 1947-48 by its predecessor, the National Advisory Committee on Aeronautics. He said although the $3.6-million Fiscal 1962 addition requested above the $31 million NASA spent in Fiscal 1961 on aeronautical research will take care of immediate needs, "I personally believe that a future increase will be warranted next year."

Since its formation in 1958, NASA has increased research in the V/STOL aircraft field, Abbott said, and intends to continue a "vigorous program." He said the electronic breakthroughs made in the space program promise to provide the technology needed to control V/STOL airplanes with the necessary precision.

In the supersonic field, Abbott said NASA is concentrating on the Mach 2-4 range, adding that now "all supersonic aircraft lack the versatility to which we have become accustomed in subsonic aircraft and resemble in this respect the aircraft of 30 or more years ago."

Maj. Gen. Bruce K. Holloway, Air Force director of operational requirements, told the House space committee that the military services also feel the manned aircraft will continue to play a vital role, both in war and peace. He said the tactical fighter "must constitute the backbone air weapon of limited war for the indefinite future."

He added that the services hope to have the TFX fighter "in the inventory" within five years, an airplane proposed to serve the tactical fighter and interceptor needs of all three military services. Gen. Holloway said that although the TFX will be a STOL airplane, "we are still very much interested" in VTOL aircraft. He also pointed out that a major effort, headed by the Navy, is under way to develop a tri-service VTOL transport.

New York Airways Vertol 107 Makes First Flight

Boeing Vertol 107 twin-turbine helicopter ordered by New York Airways makes its first flight at Morton, Pa. The airline has ordered five of the 155-mph., 25-passenger 107s, which are powered by two GE T58 turbine engines, for delivery late this year.

Helicopter Service Recommended For Transportation to Airports

Washington—Helicopter service—not satellite terminals, limited access highways or interconnecting mass transit systems—is the best way to make the average metropolitan airport more accessible to airline passengers, according to a study prepared for the Federal Aviation Agency.

Prepared by Human Sciences Research, Inc., the 400-page study concludes that helicopters "offer considerable potential promise for at least a partial solution to airport transportation problems." It also states that only the helicopter industry in its field is "actively and aggressively attempting to introduce and promote a new concept in airport transportation."

However, the helicopter's promise is partially offset by the typical heliport's distance from passenger origination and destination points and by the time passengers now must wait for helicopter flights, according to the study. For passengers originating in or bound for outlying areas around a large city, it probably would be "as much trouble to get to the heliport as it would to go directly to the airport," the study observes.

Even though the building of better access highways would shorten vehicle travel time to the airport, authors of the study feel that the entire network of roads around a terminal would have to be improved in order to produce a "significant total effect." This is because widely scattered areas normally generate the passengers that use an airport.

Mass transit systems—buses, subways or railroads—do not hold much potential because experience shows that passengers will choose to travel by other means, principally by automobile, if this can be arranged. Satellite airports would ease the transportation problem for nearby residents, especially if located downtown where concentrations of hotels produce about one-third of a metropolitan airport's total boardings.

As to long-range future solutions, the study raised the possibility of a system built "on a small module concept" and involving a large number of relatively small, low-capacity conveyor units. Some of these would operate on schedules while others would be held in reserve to cope with fluctuating demand within a vast area where the number of passenger origin and destination points varied widely.

Distributed throughout this area would be a set of "collection and distribution" points. At one of these, passengers bound for a common destination might "coalesce into a larger unit which would make use of extremely high-speed transit to the destination point (which might be a distributing point from which the module units would depart independently for destinations in the near vicinity)." But such a system, the study admits, could only be implemented as part of a general urban transportation plan.

Air France 707-328 Crashes in Hamburg

Paris—Air France 707-328 en route for Tokyo crashed and caught fire while taking off from Hamburg, West Germany, July 28. There were no fatalities among the 28 passengers and 15 Air France personnel aboard. Aircraft fuselage broke in three places and probably is a total loss.

Air France said the airplane was well down the runway when it swerved to the left, presumably because of a blockage in the brake system. The pilot immediately cut off fuel to the engines and attempted to bring the aircraft to a halt. It skidded off the runway and ended 600 ft. from the end of the runway and 100 ft. to the left. Aircraft ploughed through a runway extension construction project and its engines caught fire when the pods scraped along the ground. Delivered in November, 1959, the aircraft had just come out of major overhaul.

Carriers Briefed On Lockheed Model 300

Washington—Lockheed Aircraft Corp. has started briefing interested airlines on the performance and specifications of the Lockheed 300, commercial version of the C-141 swept-wing, turbofan-powered freighter ordered for Military Air Transport Service.

The transport, to be powered by four Pratt & Whitney TF33-P-7 turbofans developing 21,000 lb. thrust on takeoff (AW Mar. 27, P. 24), will come equipped with the Air Force mechanized loading system 463L.

British SST Decision

London—Decision on British development of a supersonic transport if any, must be made within the next two or three months, according to Sir Matthew Slattery, BOAC chairman, who added: "I don't want a supersonic transport at all."

Slattery contended that a supersonic transport will not be a factor in lowering air fares and said he considered the airplane "an infernal nuisance, and I think the Americans agree with this. The trouble is that they are afraid the Russians are producing one" (AW July 31, p. 36).

Any British effort involving a Mach 2 airplane, he said, would have to be three or four years earlier than the U. S. development of a Mach 3 type. Slattery said he thought the Mach 3 estimate of 1970-71 was "overly optimistic."

Beacon Favors Proven Control Concepts

By David H. Hoffman

Washington—Project Beacon report will forecast that familiar tools and techniques—not radically new devices such as height-finding radar or Data Processing Central—will be the backbone of the air traffic control system for the next five years.

But the Beacon report in the form now being studied by White House staff members would impose significant new burdens on the air traffic control (ATC) system by expanding the airspace in which aircraft are required to fly under Federal Aviation Agency's instrument flight rules.

Congressmen and industry representatives have been briefed privately on the forthcoming report by FAA Administrator N. E. Halaby and Beacon task force chairman Richard R. Hough. These briefings indicate that the report, compiled under President Kennedy's orders, will urge Congress to furnish, when necessary, the fiscal support that would enable FAA to:

- **Blanket almost the entire U. S.** with "positive control" airspace. In this airspace, which is to extend upward from an altitude of about 14,500 ft. except in mountainous regions, visual flight rule (VFR) operations would be banned and all aircraft at some future date probably will need altitude-reporting or coded transponders. Positive control now is provided only in the Chicago-Indianapolis area and on three intermediate altitude transcontinental airways.
- **Establish arrival and departure** "ramps" leading downward to, or upward away from, the active instrument runways at major metropolitan terminals. These ramps, actually three dimensional airways, would alleviate the need for terminal area holding patterns and establish some type of separation between aircraft converging on a busy airport. The ramp concept is similar to one proposed in the five-year-old Curtiss Committee report on ATC modernization.
- **Develop and install** an automatic device that would furnish pilots with a "hard copy" of their IFR clearance prior to takeoff and preferably before ramp departure. Under present practice, pilots copy complicated departure and en route clearances just before beginning their takeoff roll. Even though these clearances are "read back" to the tower for accuracy, misunderstandings constantly occur within the system.
- **Draft rules defining** a new type of clearance—CVFR for "controlled visual flight rule" operation—that would enable pilots not fully qualified on instruments to participate in the IFR system. Special minimums, such as an in-flight visibility of one mile or more, would be established for CVFR flights. Other conditions would be laid down on a flight-to-flight basis by the appropriate ground controller.
- **Raise minimum en route** altitudes from 1,000 ft. above the highest obstacle along an airway to about 3,000 ft. The extra 2,000 ft. gained would be used as a tunnel for light aircraft, and in this manner, mixing of IFR and VFR traffic would be minimized. At the same time, aircraft flying beneath the airway's "floor" would be limited to a certain speed, probably 200 kt.
- **Use altitude-reporting** beacon equipment in lieu of the three-dimensional radar that FAA once hoped would become operational in September or October of 1962. In line with this Beacon recommendation, FAA has requested industry to submit bids for a contract to develop a "small light-weight altitude transmitting equipment" (SLATE) that would automatically report heights in 500-ft. increments from sea level to 10,000 ft. FAA asked for bids on the basis of 10,000 units, and Beacon task force members have said that the price should be held to about $500. SLATE would be required on aircraft weighing more than 12,500 lb.

Both Halaby and Hough are reported to have dodged questions posed during briefings on whether FAA is willing to absorb Air Force's SAGE system, in its entirety, as an ATC tool. The Beacon group reportedly had not reached a final decision on this subject because Halaby still was negotiating with the Defense Department. Nevertheless, the FAA administrator is known to feel that it would be more expensive to modify SAGE for ATC use than it would be to develop an original system.

As long as the Air Force relies on SAGE, the system's computers cannot be made an integral part of the civil traffic control system, Halaby believes. SAGE long-range radar, now used to provide both civil jet advisory service and military ground controlled intercepts, should be examined even more closely for possible new ATC applications, he feels.

To date, FAA has not officially revised its estimate that the first Data Processing Central (DPC) system would be commissioned in November, 1962, at Boston's new ATC center. At a recent press conference, however, Halaby reported that the Project Beacon task force was reviewing DPC and could be expected to state whether DPC "should be retained as a systems concept."

The fact that neither Hough nor Halaby singled out DPC as even a partial answer to terminal area congestion indicated to observers that the DPC prototype system now at FAA's Atlantic City, N. J., experimental center must undergo considerably more testing before the Boston installation begins to print and update actual flight progress strips.

An expected Beacon report recommendation that FAA be given greater authority to influence the design and location of new airports probably will encounter stiff congressional opposition. A formal amendment to the Federal Airport Act passed by the House last week ruled that only with the consent of the local board of supervisors could FAA retain Long Island's deactivated Mitchel Air Force Base as a field for general aviation use. Local interests probably would defeat similar FAA moves elsewhere in the absence of strong White House backing.

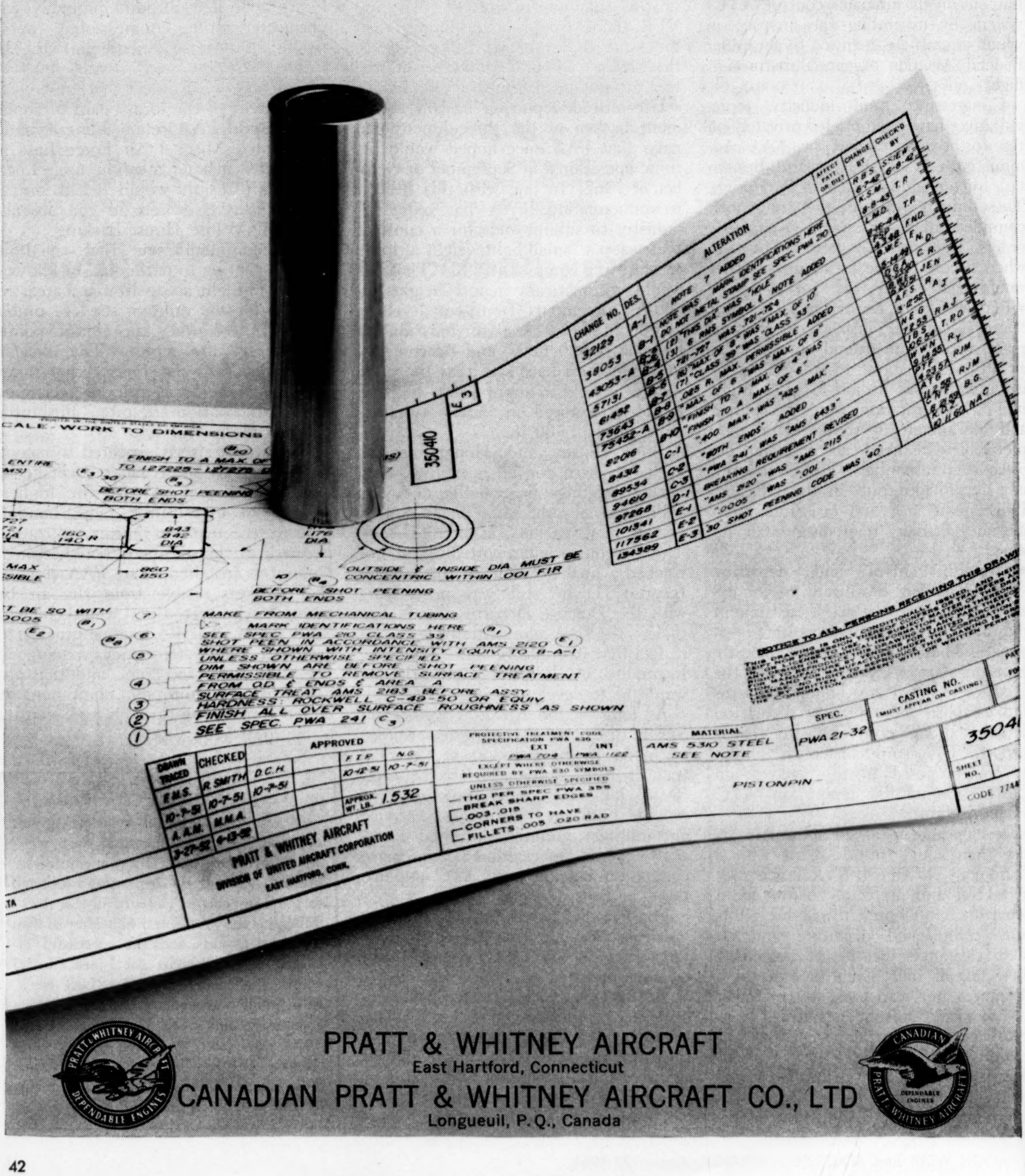
A recommendation that aviation, general aviation in particular, be allowed limited in-flight access to many areas restricted for the military services probably will be among the minor points covered by the report. The Beacon committee does not foresee that many more of these areas can be reclaimed for civil aviation despite substantial progress made by FAA.

The report also is expected to recommend that en route radar coverage be expanded, that FAA give the highest priority to establishing radar handoff procedures, that maximum utilization be made of the so-called "bookkeeping" computers installed in six FAA centers, that markers visible from the air be painted wherever they would benefit VFR pilots, that FAA move quickly to establish 50-kc. frequency spacing in the VHF radio spectrum, and that aircraft lacking certain radio equipment be barred from flying through high density traffic areas.

Hijacking Problems

Washington—Federal Aviation Agency ordered preventive measures last week and the Senate Aviation Subcommittee opened hearings on legislation designed to prevent "acts of violence in the skies" following the attempted hijacking of two airline transports and the successful hijacking of an Eastern Air Lines Electra within the past two weeks. Last week, an attempt was made to commandeer a Pacific Air Lines DC-3 at Chico, Calif. Three days later, two men held a Continental Airlines 707 at El Paso, Texas, in a hijack attempt before authorities were able to force their surrender.

This piston pin is a good example of the constant improvements in Pratt & Whitney Aircraft original equipment parts. The production blueprint shows that 18 changes have been made in the original specifications. The panel at right lists them chronologically, from 1942 through 1960. An aircraft engine is only as dependable as its component parts. You can be sure of your engine's performance if you specify original equipment parts for repair or overhaul. They are available direct from Pratt & Whitney Aircraft or from its authorized distributors in the United States and Canada.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CANADIAN PRATT & WHITNEY AIRCRAFT CO., LTD
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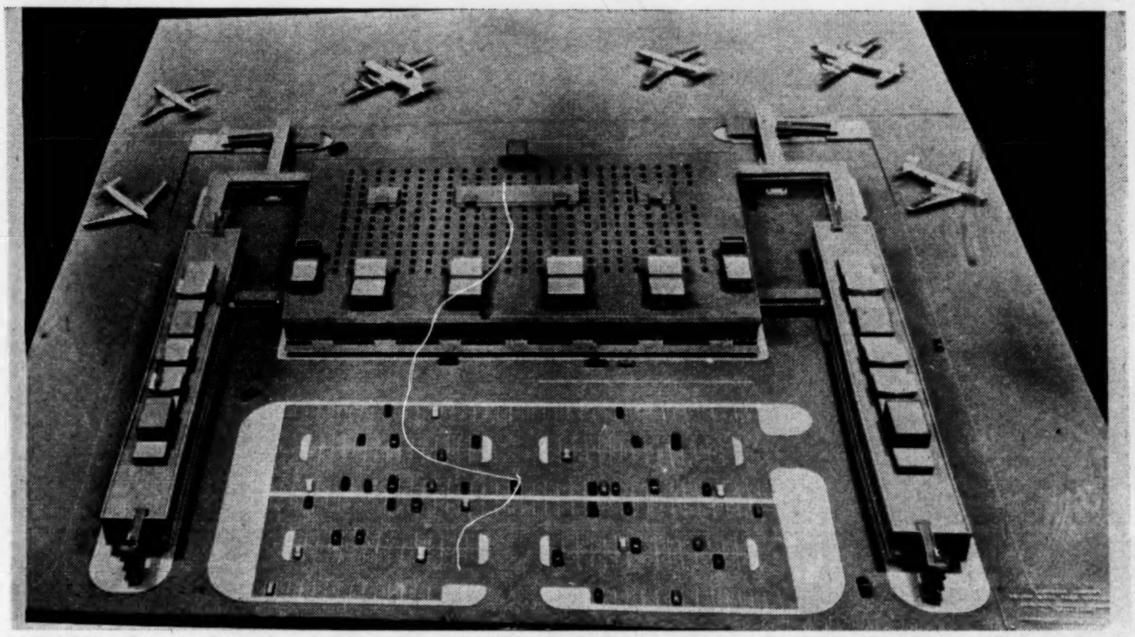
London Airport Authority Gets Approval

By Herbert J. Coleman



MODEL of new long-haul passenger traffic building now under construction at London's Heathrow Airport shows layout and aircraft parking positions.

London—British government will decentralize its operation of London international airports by setting up an authority system to own and manage Heathrow and Gatwick, Minister of Aviation Peter Thorneycroft said here last week.

The Ministry move came surprisingly soon after a parliamentary Select Committee on Estimates recommended formation of an authority on the lines of the Port of New York Authority to streamline operations and cut costs in a report highly critical of financial controls and planning.

Ministry of Aviation will retain control of the technical services, such as traffic controls, but the new authority, in addition to its other duties, will oversee the London heliport now in planning (AW July 31, p. 39).

In addition to Heathrow and Gatwick, Stansted Airport, now used for training but which has been earmarked for "care and maintenance" status, is covered in the report. Early decision on possible development of Stansted as a third major airport, capable of handling supersonic transports within 15 years, was urged by the committee.

The report is the first searching inquiry into the airports since 1955-56 when management was directed to devote attention to revenue from non-aviation sources. Since that time, the report notes, landing fees have more than doubled. Among the committee recommendations:

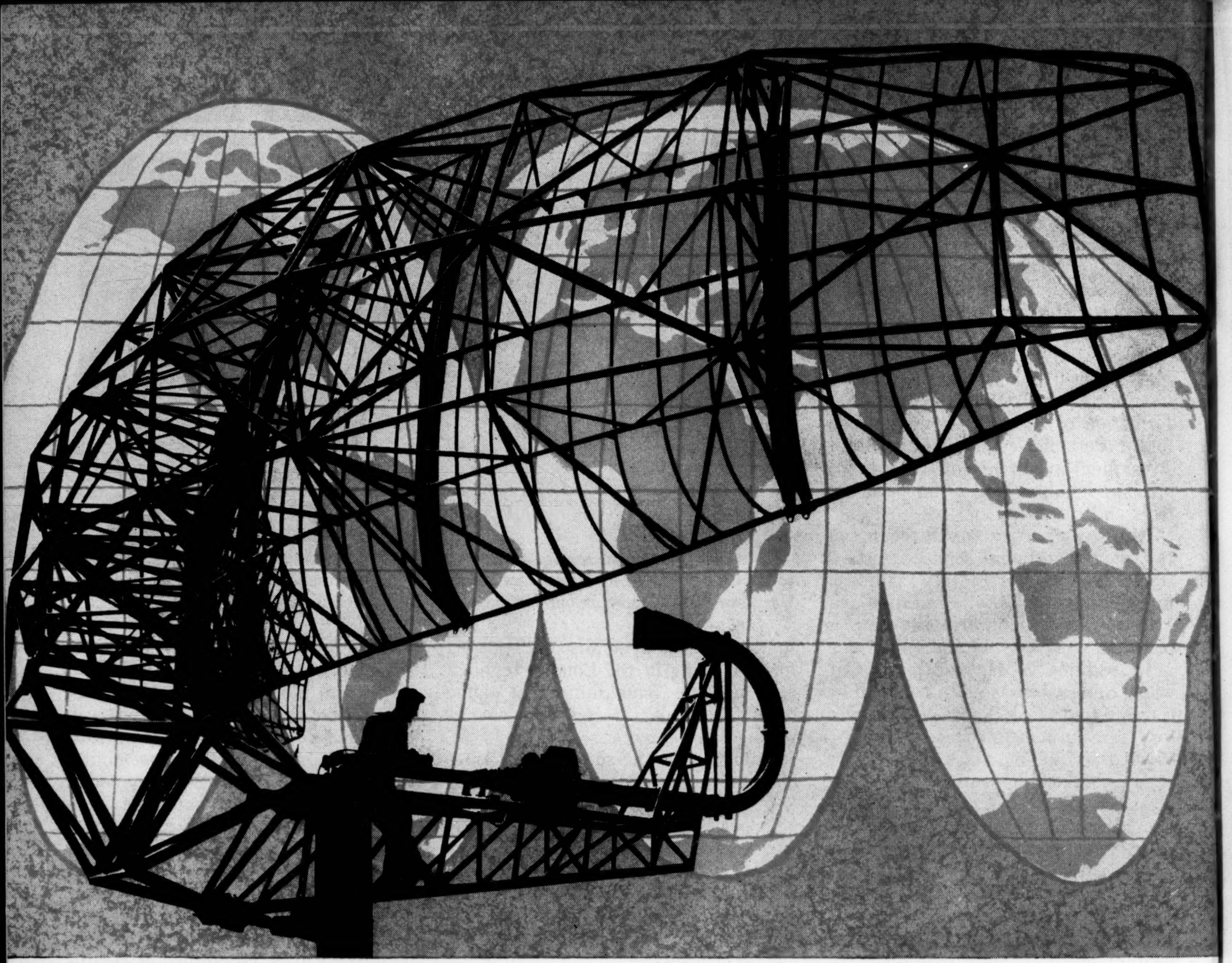
- **Minister of Aviation** should continue to be responsible for divisional air traffic control and accident investigation. Cost of providing other technical services should be borne by the authority.
- **Urgent consideration** should be given to the expansion of airspace available for civil flying in the London terminal area and the establishment of traffic control for military and civil aircraft in one control center.
- **Reduction of the surcharge** on landing fees payable for aircraft landing after an intercontinental flight.
- **Calculation of a differential** on landing fees at Heathrow (main London airport) between peak and off-peak periods for those airlines which could achieve a sufficient number of scheduled off-peak movements to make the scheme worthwhile.
- **Encouragement of use** of Gatwick for business and private airplanes.
- **Transferral of all ramp services** at Heathrow to the airlines, if airlines assume responsibility for ramp buses. Passenger service charges should be standardized and the 7% rebate to airlines for collecting this fee should be substantially reduced.
- **All future contracts** with companies for supply of fuel should be based upon the amount of business done. At present, revenue remains static, despite gallonage moved, in what the committee described as a "deplorable agreement."
- **Duty-free shops** should be provided and construction of a multi-story carpark should be expedited for Heathrow.
- **Ministry of Aviation** should meet with the Air Ministry to explore the possibility of removing operations from Northolt Airport, which has light use, so that a preferential runway system to the west could be established at Heathrow. This was suggested by the Foreign Airlines Assn.
- **Ministry should examine** all possibilities of expanding air cargo facilities at London.
- **Establishment of a rebate** on landing fees for flights between Gatwick and Heathrow for maintenance or positioning purposes. At present, if jet trans-

Comparative Airport Charges—Jan., 1961

(Britannia 312 and Boeing 707-420)

	London (Present)		London (Proposed)		Rome		Beirut		Calcutta		Karachi		Singapore		Sydney		Montreal		New York		Chicago	
	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707	B312	B707
1. Landing fee	$283	$510	$375	$680	$109	$179	$67	$112	$64	$157	$67	$157	$129	$224	$218	$465	$216	$406	$64	$109	$53	$81
2. Passenger service charge	56	84	56	84	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3. Passenger ramp and apron charge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11	11	...	...
4. Incinerator service charge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.34	.34	...	...
5. Porter service charge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39	59	8	11
6. Inspection service charge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	90	134	6	8
7. General terminal charge	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	...	...
Total	339	594	431	764	109	179	67	112	64	157	67	157	129	224	218	465	216	406	212.34	321.34	67	100
8. Night operational fee	...	...	...	...	56	90	3	3	...	...	17	17	...	...	...	...	...	...	...	...	...	...
9. Air navigation facilities charge	...	...	...	...	11	11	...	...	...	...	...	...	...	...	...	...	90	90	6	6	...	...
10. Non-recoverable fuel duties, and taxes	...	...	...	...	.42	.42	8	17	120	227	...	...	...	...	...	...	25	45	...	...	14	25
11. Storage facilities	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	28	...	...
12. Allied aviation handling	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45	84	...	...
Grand Total	339	594	431	764	176.42	280.42	78	132	184	384	84	174	129	224	218	465	331	541	280.34	439.34	81	125

*Compiled by BOAC



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ELECTRONIC SERVICES DIVISION

European International Airport 1960 Traffic

Airport	Total Passengers	Air Transport Movements	Total Movements
London Area Airports	5,935,420	156,660	215,559
London (Heathrow)	5,381,735	135,468	146,506
Paris (Orly and Le Bourget)	3,488,661	91,886	126,341
Frankfurt	1,906,158	76,852	85,257
Copenhagen	1,782,720	66,825	74,512
Zurich	1,330,733	49,272	101,800
Stockholm	1,052,033	42,890	76,117
Dusseldorf	934,949	41,498	58,904
Brussels	880,720	41,017	53,517
Hamburg	923,376	35,695	54,619
Berlin	1,532,035	34,969	36,231
Geneva	854,562	29,967	56,014
Marseilles	838,708	21,195	36,840

Compiled by the Ministry of Aviation

ports use Gatwick as an alternate for landing, they must fly light to Heathrow and thus pay a double landing fee.

- **Plans for runway development** at Gatwick should be revised to include at least one runway suitable for jet aircraft takeoffs at full gross weights.

The London group of airports has consistently lost money, and the committee considered that the "unsatisfactory condition of the finances of London's airports is principally the result of a failure until comparatively recently to regard them as commercial undertakings." The Treasury was criticized for failure to perceive a "major deficiency" in financial controls over nearly a 10-year period.

On the other hand, the committee and the airlines agreed that management of the airports has been, in the main, "conscientious and competent, particularly at the local level at the airports." Committee said it agreed with A. H. Milward, chief executive of Britsh European Airways, who said:

"If . . . I indicate that there are faults, or there have not been substantial improvements, it is because of the system or type of organization, and not because of the people."

On the whole, both BEA and British Overseas Airways Corp., the state-owned airlines which have long advocated the authority system, were sharply critical of operations at Heathrow and Gatwick. As BEA put it: "Cost per movement at state-operated airports in this country appear to be at least twice as high as, for example, in the United States . . . this high cost is reflected in the excessively heavy charges made at Ministry of Aviation airports."

BEA charged that British air transport is at present "unduly handicapped by the excessively uneconomic way in which its ground facilities are being provided." The airline claimed that a "civil service approach" to solution of management problems is often "quite inappropriate" to an undertaking of this kind [airports].. Government officials, BEA continued, tend to pay insufficient attention to commercial considerations and, in the face of rising expenditures "almost inevitably fall back on the repeated increases in charges instead of making sufficiently forceful efforts to improve the over-all economy of the airport by reducing expenditure, by stimulating utilization and by seeking new sources of revenue."

BEA said the Port of New York Authority is an "excellent example of the type of organization we have in mind."

Referring to air cargo operations, Milward said BEA has spent $1.5 million on temporary freight accommodations at London (Heathrow) Airport "because we have been totally unable to get any permanent freight accommodation at all."

Case for expanded cargo operations was also pressed by BOAC's managing director, Sir Basil Smallpeice, who told the committee that London was "slipping in this area." He predicted that, with adequate cargo-handling facilities, London could become the focal point of Europe.

Smallpeice added that BOAC was in favor of an independent authority on the grounds that costs could be reduced under a more commercial management than the present Ministry of Aviation control. But BOAC recommended that air traffic control should remain in the Ministry province.

On airport charges, BEA's Milward claimed that the cost for a Boeing 707 at Idlewild Airport is about $263, while the comparable cost at London is $742, in backing his contention that London airports are among the most expensive in the world.

However, the Ministry took issue with this comparison and told the committee that the figures are "incomplete in their treatment of charges falling on airlines operating to Idlewild and fail to recognize that the airlines at Idlewild have to meet separate additional costs which are covered by the aerodrome at London in its inclusive fees.

Turning to BEA's accusation that the Ministry was guilty of "shilly-shallying and procrastination" in regard to freight accommodations, the Ministry retorted: ". . . The reason the Ministry has not provided permanent freight accommodation at an earlier date is neither lack of finance . . . nor deliberate procrastination in the hope that this would force BEA to provide the building themselves. It has been due to the Ministry's determination that London [Heathrow] shall be planned with regard to future requirements and to the long-term development of the airport."

Officials said that had the Ministry gone ahead with a freight scheme first proposed in 1954, the freight shed would have been both inadequate and in the wrong place, and it would have been impossible to put the new, long-haul terminal, now in final construction stages, in the right place.

Added Support

Further backing for establishment of an independent authority came from Sir William Hildred, director general, International Air Transport Assn., who said IATA's position is that the authority would be in a better position to cope with airport economics.

IATA claims that the Ministry "in its monopoly position as a provider of the principal airports has adopted the policy of charging fees that are not consistent with a reasonable level of costs, compared with those of other airports." IATA says the higher level of landing fees will deter normal growth at London and other U. K. airports.

In a discussion of charges at London, Hildred told the committee that "none of our members will attempt to boycott London or fail to serve the public," but he added that it is clear that "where there is any possibility of avoiding a transit stop, if an airline can bypass London and drop down, say, at Frankfurt, they will in future do so because they feel the charges here are extremely high. . . ."

Hildred indicated that London charges, and lack of facilities, could hurt the United Kingdom in attracting air cargo business. He also said that other airports could follow London's example in raising landing fees and that he favored a 20-month easement in inaugurating charges.

In a letter to Hildred, Minister of Aviation Peter Thorneycroft said the Ministry could accept that London charges are "toward the top of the international bracket," but claimed they are not out of line with total costs which airlines have to meet at comparable airports. In particular, he referred to airline construction of terminal facilities, and charges for lighting, fuel and services.

Thorneycroft said he could not accept the proposition that the British taxpayer should help finance terminal charges of the airlines by imposing subsidies.

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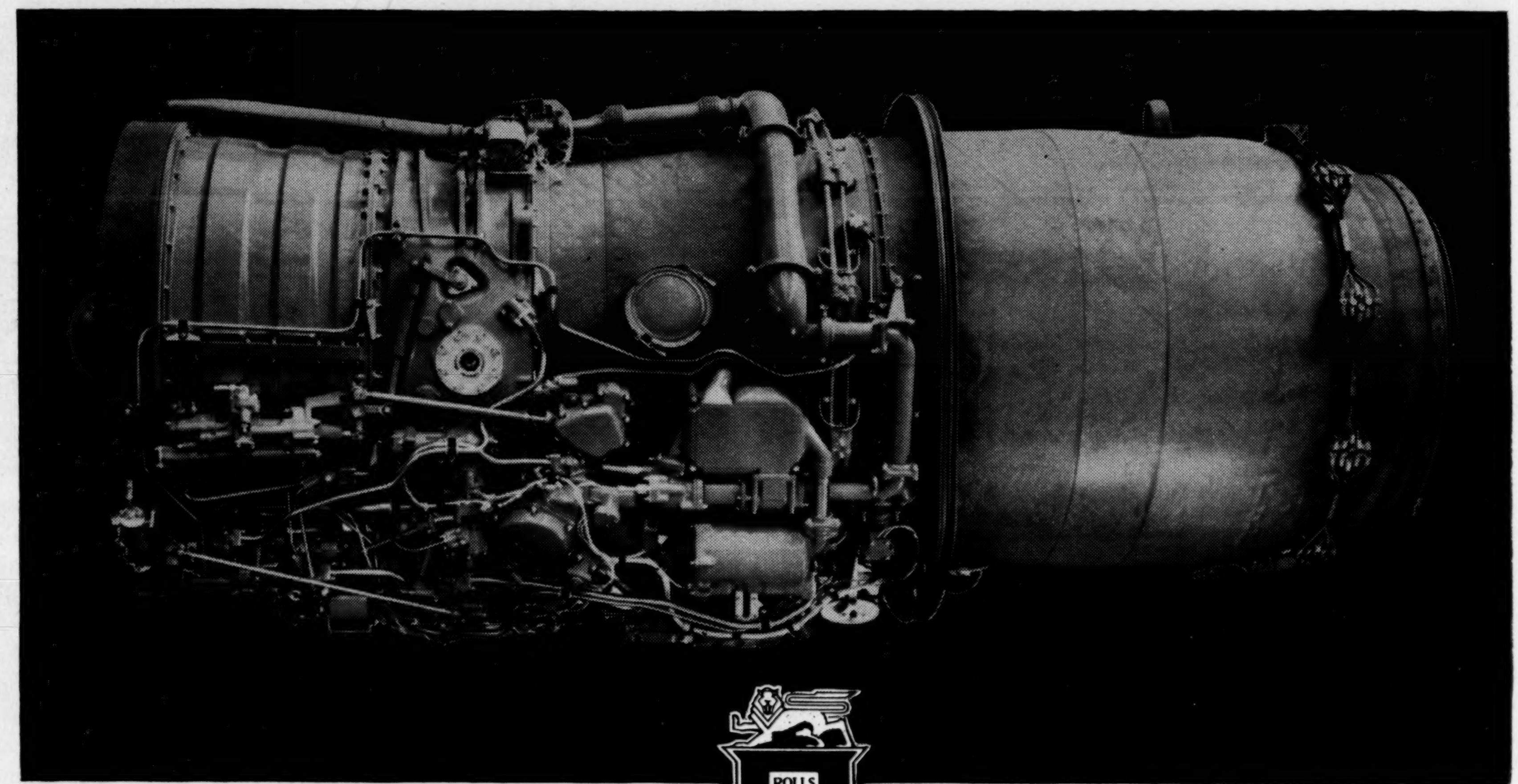

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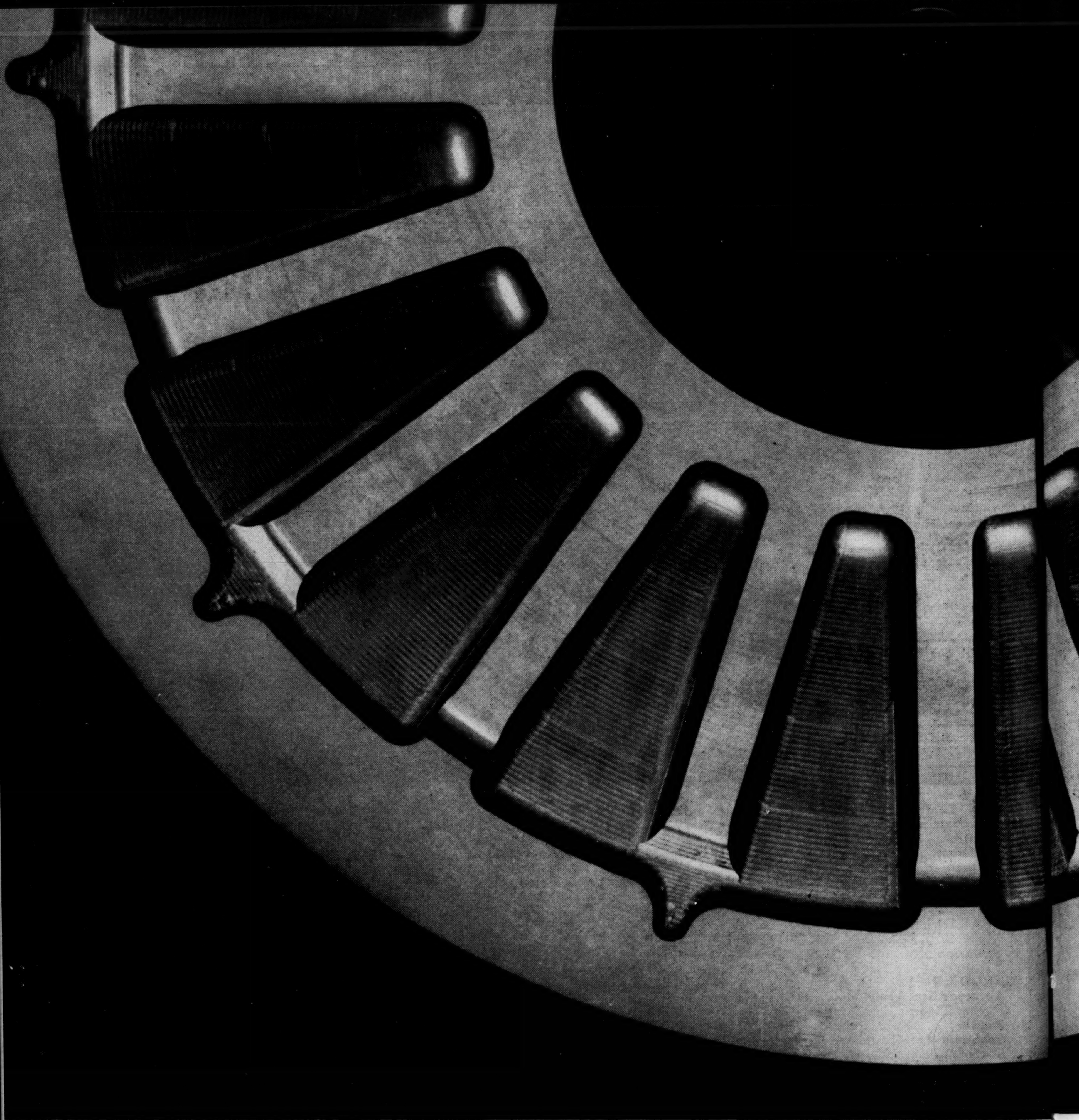
Airline Income and Expenses—May, 1961

(IN DOLLARS)

	Passenger Revenue	U.S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	31,218,167	756,497	381,917	2,224,849	-----	35,081,244	34,321,032	760,212
Braniff	5,858,620	148,367	63,487	246,782	30,826	6,454,579	6,514,803	- 199,345
Capital	7,835,696	215,093	127,882	142,589	25,292[1]	8,437,320	9,168,652	- 1,601,959[2]
Continental	4,673,000	99,000	41,000	145,000	3,000	5,082,000	4,805,000	141,000
Delta	11,457,000	227,000	125,000	366,000	-----	12,475,000	11,546,000	723,000
Eastern	19,579,188	489,246	-----	1,025,262	2,484	21,289,723	23,990,886	- 3,011,947
National	2,774,070	71,181	13.611	147,124	66,485	3,197,542	4,620,963	- 1,553,319
Northeast	4,007,703	57,451	30,021	100,582	-----	4,299,100	4,740,298	- 639,098[2]
Northwest	5,842,756	189,364	-----	402,628[3]	10,281	6,514,060	6,282,237	13,829
Trans World	20,757,984	459,331	-----	1,392,381[3]	272,704	23,039,998	24,169,534	- 2,182,200
United	30,960,527	1,172,287	-----	2,554,087[3]	99,038	35,362,362	33,814,470	1,608,410
Western	4,025,391	102,998	-----	178,234[3]	33,514[1]	4,357,903	4,229,219	- 39,216
INTERNATIONAL								
American	334,012	5,000	332	60,399	-----	424,424	499,084	- 74,660
Braniff	759,603	34,548	-----	50,082	-----	891,240	1,187,946	- 319,940
Caribbean Atlantic	262,849	3,520	-----	15,378[3]	700	287,017	296,101	- 8,238
Delta	116,000	1,000	-----	2,000	-----	124,000	241,000	- 123,000
Eastern	2,236,726	80,604	-----	158,301	-----	2,476,236	2,778,355	- 342,295
Mackey	132,069	-----	714	4,419	-----	150,587	151,768	- 2,231[2]
Northwest	2,225,615	655,047	-----	325,788	21,991	3,420,993	2,686,354	627,921
Pan American Combined	27,663,000	2,684,000	-----	3,321,000	2,771,000	37,803,000	33,957,000	3,317,000
Alaska	354,000	16,000	-----	43,000	-----	417,000	438,000	- 10,000
Atlantic	13,691,000	1,141,000	-----	1,285,000	1,277,000	18,066,000	15,427,000	2,880,000
Latin America	5,959,000	209,000	-----	1,057,000	74,000	7,804,000	8,555,000	- 640,000
Pacific	7,659,000	1,318,000	-----	936,000	1,420,000	11,531,000	9,531,000	2,220,000
Panagra	1,187,000	58,000	-----	205,000	7,000	1,703,000	1,906,000	- 226,000
South Pacific	37,518	192	-----	1,439[4]	-----	42,211	103,376	65,849
Trans World	5,449,189	676,141	-----	602,330[3]	139,684	7,024,293	7,505,333	- 757,516
United	1,599,629	92,455	-----	61,206[3]	-----	1,777,965	1,374,214	364,469
Western	330,031	5,245	-----	13,002[3]	-----	350,312	420,522	- 81,270
LOCAL SERVICE								
Allegheny	1,128,819	21,649	22,679	35,567	-----	1,767,122	1,681,241	53,175[2]
Bonanza	348,496	7,404	2,432	6,793	8,060	573,699	639,045	- 84,910
Central	286,600	12,500	5,100	12,977	549	832,502	673,260	155,268[2]
Frontier	543,742	17,232	4,874	27,879	2,500	1,132,771	1,174,269	- 54,874
Lake Central	513,987	10,750	10,169	8,843	853	915,974	871,290	31,604[2]
Mohawk	1,025,097	16,772	17,395	21,998	33,403	1,522,677	1,362,065	119,793[2]
North Central	1,251,782	33,100	22,700	36,569	-----	2,044,796	2,062,409	- 38,117
Ozark	701,476	19,217	14,892	24,813	11,619	1,175,617	1,066,509	95,246
Pacific	544,097	13,771	3,485	9,900	62,192[4]	963,173	861,763	71,564
Piedmont	761,049	11,519	7,136	14,316	-----	1,237,893	1,111,623	104,931
Southern	485,836	19,450	6,320	15,431	5,699	890,749	821,564	60,106
Trans-Texas	462,088	13,023	5,690	21,926	3,565	845,248	859,465	- 19,974
West Coast	542,127	11,060	1,667	13,154	1,468	1,016,693	899,951	101,633
HAWAIIAN LINES								
Aloha	346,870	2,400	-----	5,488	-----	408,981	433,820	- 49,310[2]
Hawaiian	480,703	4,396	-----	75,101	-----	615,234	632,557	- 37,781[2]
CARGO LINES								
Aerovias Sud Americana	-----	-----	-----	-----	-----	173,257[5]	148,471	24,785
Flying Tiger	-----	7,713	-----	903,402[3]	1,404,033	2,351,326	2,117,896	184,494
Riddle	274,392[6]	-----	-----	1,641,302	-----	1,817,804	1,203,481	88,105[2]
Seaboard World	-----	432,675	-----	754,871	423,014	1,622,643	1,915,894	- 328,200[2]
Slick	-----	-----	-----	-----	616,945[4]	651,944	621,390	- 2,088[2]
HELICOPTER LINES								
Chicago Helicopter	129,206	135,898	-----	-----	-----	265,154	286,166	- 18,087
Los Angeles Airways	23,012	15,168	12,196[7]	-----	-----	140,451	142,556	- 905
New York Airways	92,566	4,438	2,462	2,944	-----	306,671	335,795	- 30,959
ALASKA LINES								
Alaska Coastal	105,173	10,405	-----	11,677	3,395	185,347	185,259	- 2,060[2]
Ellis	67,000	5,000	-----	7,400[3]	2,600	113,500	105,800	7,200[2]
Kodiak	19,819	1,130	-----	3,156	6,217	33,889	27,297	6,084[2]
Northern Consolidated	121,037	69,905	-----	41,577	-----	320,849	286,103	11,750[2]
Pacific Northern	689,732	82,922	3,852	146,517	345	1,059,000	944,310	109,450
Reeve Aleutian	177,506	46,311	-----	46,402[7]	29,328	308,523	203,513	104,609
Western Alaska	8,009	6,469	-----	681[7]	4,930	20,599	20,673	- 3,763[2]
Wien Alaska	101,463	75,553	-----	40,443	53,451	418,322	419,865	- 10,195

[1] Includes other transportation. [2] Net profit or loss. [3] Property. [4] Includes contract revenue. [5] Air Force contract. [6] Mats. contract. [7] Includes excess baggage. Data for Trans Caribbean, Alaska Airlines, Cordova and Avalon were not available.

Compiled by Aviation Week from reports to the Civil Aeronautics Board.

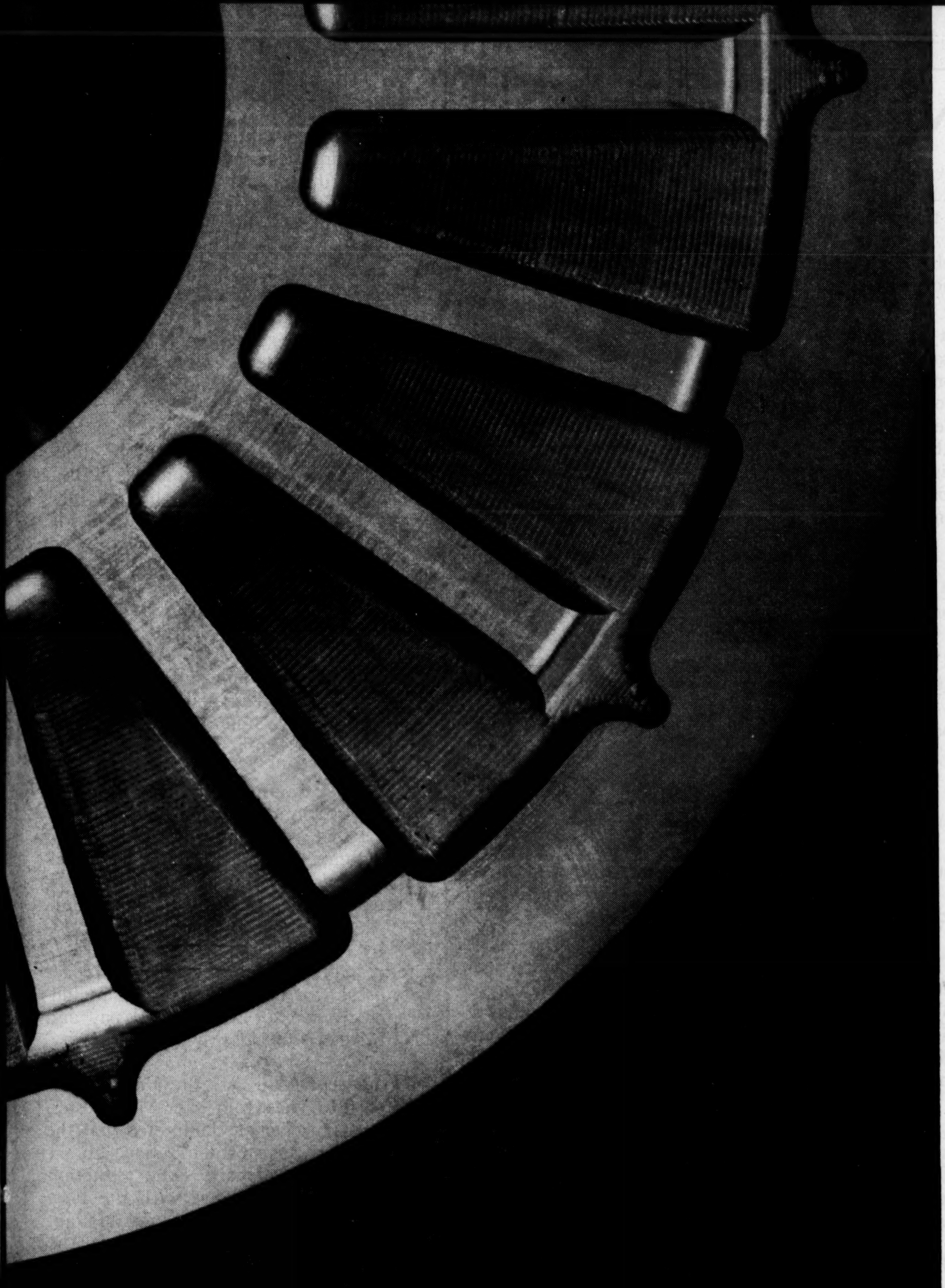


New IBM computer language...AUTOPROMT cuts milling time for this helicopter gearbox cover by 75%

AUTOPROMT (AUTOmatic PROgramming for Machine Tools) is a powerful new computer language designed to broaden the use of numerically-controlled machine tools.

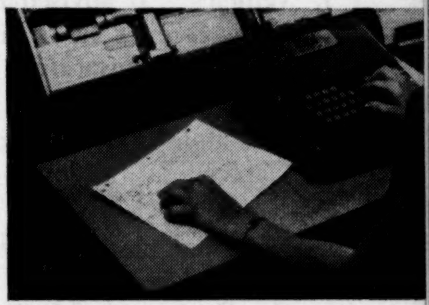
AUTOPROMT, for the first time, lets an engineer *describe the surfaces* of the three-dimensional shape he wants milled, *rather than calculating every path* the tool must follow in order to machine the part.

AUTOPROMT leaves to the computer the task of automatically generating these tool paths. You describe the part to be milled and the tool to be used in simple, *English-like*



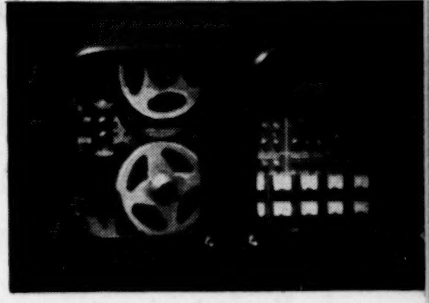
Here's the way AUTOPROMT works at United Aircraft Corporation

The Parts Programmer, using a conventional blueprint, prepares 180 one-line statements in AUTOPROMT language.



The statements are punched into standard IBM cards and entered into the IBM 7090 Data Processing System. (AUTOPROMT also works with the 704 and 709 Systems).

The 7090, programmed with AUTOPROMT, produces 8000 tool path instructions needed to direct the Pratt and Whitney Co. Inc. Numeric-Keller Continuous Path Milling Machine.



Punched tapes direct the Numeric-Keller Milling Machine.

The Numeric-Keller mills the helicopter gearbox cover.

terms. The computer does the laborious calculating work.

AUTOPROMT produces results like these: the time to mill the gearbox shown in the photographs cut to *one-fourth* the machine time required by conventional methods. AUTOPROMT reduced the lead time from blueprint to production *from three months to two weeks.*

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AIRLINE OBSERVER

▶ Look for Federal Aviation Agency to announce the formation of a technical study group to pinpoint and improve the accuracy of altimeters now installed on airline transports. FAA's purpose is to conserve airspace by reducing the separation between aircraft operating under instrument flight rules and to develop reliable collision avoidance systems. Commonly used altimeter designs have not been changed substantially since the 1920s.

▶ An appeal for haste in developing an entire family of air cushion vehicles, including large cargo carriers, has been made by the Russian newspaper Pravda. The publication called air cushion vehicles "the transport of the future." It said they represent a major qualitative jump in transportation development comparable to the appearance of jet aircraft in the skies and diesel locomotives on the railroads. Pravda said that "only recently have really large [Soviet] design teams been associated with work on air cushion vehicles." It advised more critical study on foreign work in this field "since many foreign air cushion vehicles have been developed purely for publicity and cheap sensation."

▶ Watch for Aerolineas Argentinas to sign an order for three Mark III Caravelles. This will bring Sud Aviation's Caravelle sales to 122 aircraft.

▶ Formal announcement of a contract for the purchase of three more Boeing 707-420 transports by British Overseas Airways Corp. is being delayed until the British Air Ministry can announce further support of British projects. The new 707s will probably be used on routes to South America replacing Comets, which will be withdrawn. Order for 707s was prompted by a delay in the delivery schedule of Vickers VC.10 transports. VC.10 delivery date is now fourth quarter of 1963, probably November of that year.

▶ Delta Air Lines has purchased four additional Convair 880 turbojet transports and three Douglas DC-8 turbofan aircraft at a total cost of $36 million for delivery in 1962. They will bring Delta's fleet of Convair 880s to a total of 16 and its fleet of DC-8s to nine.

▶ British United Airways, which operates a helicopter division, has asked the Air Transport Licensing Board for a ruling on whether helicopters can be operated over BUA's existing fixed-wing routes without making a new application. The airline feels that the ruling could have a bearing on future operations to the Continent. British United has made several studies of United Kingdom-Continent routes, based on Vertol 107 and Westland Rotodyne costs.

▶ Russia's Aeroflot reports carrying 28% more passengers and 16% more cargo during the first half of 1961 than in the same period last year. The figures show that the percentage gain in Aeroflot passenger traffic is continuing its steady drop, although the absolute unit gain apparently remains near its all-time high. During the first half of 1960, Aeroflot carried 38% more passengers than in the same 1959 period. The total gain for 1960 over 1959 was 30%.

▶ Lan-Chile Airlines, competing with Douglas DC-6B transports against Panagra jet equipment, is now in the market for a fleet of turbojet aircraft. When new equipment is introduced, the carrier will extend its terminal point in the U. S. from Miami to New York. Current loss of passenger traffic to competition is being countered by blocking off the front section of the DC-6Bs for cargo.

▶ Mexicana Airlines last week opened a privately built health, immigration and customs facility at Love Field, Dallas, capable of handling up to 100 passengers. The 4,100-sq.-ft. prefabricated structure, to cost $46,000 when fully outfitted, makes possible direct nonstop service between Dallas and Monterrey and Mexico City without need to stop at San Antonio to clear customs. Mexicana will make its new building available to other carriers as needed.

SHORTLINES

▶ **Air Line Dispatchers Assn.** has commissioned Stanford University's Graduate School of Business to make a complete study of the dispatcher's role in air carrier operations.

▶ **Air Transport Assn.** reports Jack M. Slichter will become acting vice president-traffic Aug. 8. Slichter formerly was director of passenger services for Western Air Lines.

▶ **American Airlines** reports its employes made 90,000 vacation flights on company passes during the off-peak vacation months January through June. Flights averaged more than 1,000 mi., and this traffic averaged nearly four flights per employe.

▶ **Federal Aviation Agency** has published a 120-page illustrated manual entitled Airport Design, covering layout, design, building and expansion of an airport. The manual is available at the U. S. Government Printing Office, Washington, D. C., for $2.50.

▶ **House Committee on Interstate** and Foreign Commerce has legislation before it that would grant the Secretary of Commerce $100,000 to "survey and analyze" federal and state regulations pertaining to all forms of transportation.

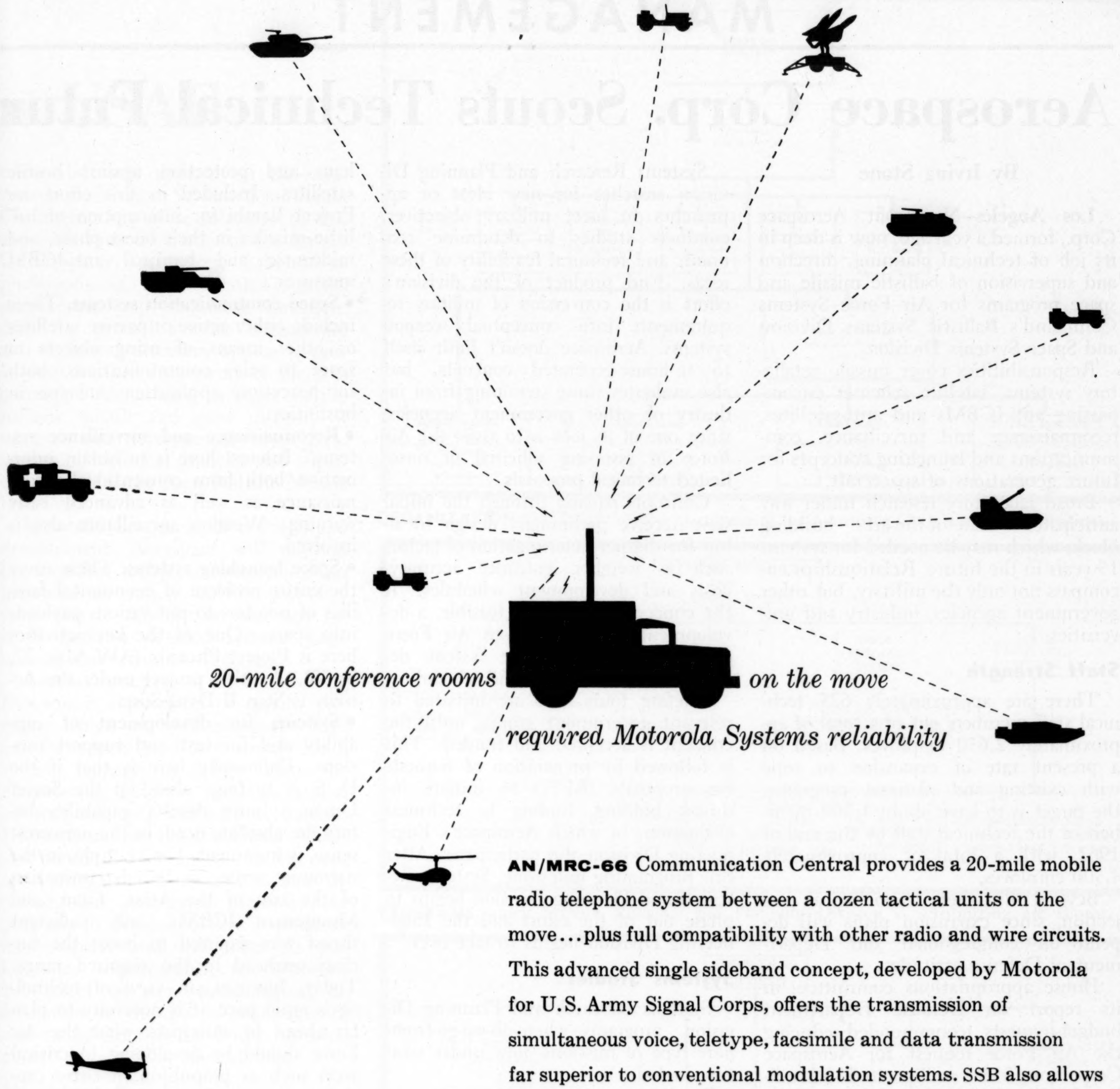
▶ **Los Angeles Airways** has forecast a total mail pay need of $2,357,321 for its fiscal year beginning Aug. 1, including $167,126 for service mail pay and $2,190,195 for subsidy.

▶ **Northeast Airlines** President James W. Austin has told the Manchester, N. H., Chamber of Commerce that the airline may discontinue service to 11 New England airports. The reduction would be in accordance with the New England Council's plan for regional airports and would mean better service, he said.

▶ **North Central Airlines'** final mail pay for service between Nov. 23, 1956, and Dec. 31, 1960, has been fixed at $20,760,833 by Civil Aeronautics Board.

▶ **Swissair** reports it flew 48 million ton miles over the North Atlantic during the first six months of 1961, an increase of 29% over the same period last year. Ton-mile capacity rose 42% during the same period.

▶ **Trans World Airlines** Europe-bound passengers no longer have to check in again when making a direct connection with a TWA international flight at a gateway city.


20-mile conference rooms on the move
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Aerospace Corp. Scouts Technical Futur

By Irving Stone

Los Angeles—Non-profit Aerospace Corp., formed a year ago, now is deep in its job of technical planning, direction and supervision of ballistic missile and space programs for Air Force Systems Command's Ballistic Systems Division and Space Systems Division.

Responsibilities cover missile retaliatory systems, satellite schemes encompassing anti-ICBMs and anti-satellites, reconnaissance and surveillance, communications and launching concepts for future generations of spacecraft.

Broad laboratory research under way anticipates state-of-the-art building blocks which may be needed for systems 15 years in the future. Relationships encompass not only the military, but other government agencies, industry and universities.

Staff Strength

There are approximately 625 technical staff members out of a total of approximately 2,650 employes. Based on a present rate of expansion to cope with existing and planned programs, the target is to have about 1,300 members of the technical staff by the end of 1962, with a total of approximately 4,500 employes.

Beyond this, there is no logical projection, since expansion plans will depend on congressional and Department of Defense attitudes.

House appropriations committee, in its report on Defense Department budget requests, recommended reducing the Air Force request for Aerospace Corp. from $35.2 million to $30.2 million for Fiscal 1962, but the $5-million cut was not made in the bill sent to the House floor. The defense appropriations bill is now before the Senate committee, but no move is under way in the Senate to reduce USAF's appropriation for Aerospace Corp.

Aerospace's organizational scientific superstructure is relatively simple. Functioning directly under the senior vice president, technical, are three divisions: Systems Research & Planning, Engineering, and Laboratories. Fanning from each of these divisions is an organizational substructure to carry on the numerous detail tasks. Members of the technical staff have horizontal responsibilities to participate, where necessary, in the work of the other divisions to ensure an efficient coordination of the scientific interfaces of the various programs.

Systems Research and Planning Division searches for new ideas or approaches to meet military objectives, conducts studies to determine economic and technical feasibility of these ideas. End product of the division's effort is the conversion of military requirements into conceptual weapon systems. Aerospace doesn't limit itself to in-house-generated concepts, but also evaluates those stemming from industry or other government agencies, since one of its jobs is to assist the Air Force in assessing solicited or unsolicited technical proposals.

Concepts passing through the initial sieve receive preliminary design to allow for sharper determination of factors such as weights, guidance accuracy, costs and development schedules. If the concept still appears feasible, a development plan evolves—an Air Force document describing the system, development details, costs and scheduling.

Briefing tours next are initiated to relevant government groups until the concept is accepted and funded. This is followed by preparation of requests for proposals (RFPs) to initiate industry bidding, leading to technical evaluation, in which Aerospace's Engineering Division also participates. After this programing milestone, Systems Research and Planning Division begins to phase out of the effort and the Engineering Division begins to take over.

Systems Studies

Systems Research and Planning Division programs—where-do-we-go-from-here type of missions—now under scrutiny include:

- **Retaliatory systems.** Approaches in this category are targeted to create deterrents which threaten retaliation, include planning programs such as an air-mobile ICBM, mid-range ballistic missile and second-generation penetration aids. A projected program is the positive control bombardment system (PCBS)—a recallable ICBM, which could involve a missile-armed satellite orbiting at 100-naut.-mi. altitude, launching missiles into re-entry trajectories against targets as distant as 5,000 to 16,000 naut. mi., depending on injection angle from orbit. Recallability would involve rendering the missile warhead inert and commanding re-entry over a preselected remote sea-area if final attack signal were not given.
- **Space defense systems.** This category is concerned mainly with additional approaches to anti-ICBM problems and protection against hostile satellites. Included in this effort are Project Bambi for interception of ballistic missiles in their boost phase, and midcourse and terminal anti-ICBM measures.
- **Space communication systems.** These include either active or passive satellites or other means of using objects in space to relay communications, both for peacetime application and use in hostilities.
- **Reconnaissance and surveillance** systems. Interest here is to obtain information both from conventional reconnaissance as well as advanced early warning. Weather surveillance also is involved.
- **Space launching systems.** These cover the entire problem of economical families of boosters to put various payloads into space. One of the key activities here is Project Phoenix (AW Mar. 27, p. 50). Another project under this activity is Step II Dyna-Soar.
- **Systems for development** of capability and for test and support missions. Philosophy here is that if the U. S. is to forge ahead of the Soviet Union, it must develop capability before the absolute need, in the narrowest sense, is imminent. For example, in the narrowest sense, in the determination of the size of the Atlas, Titan, and Minuteman ICBMs, only sufficient thrust was required to boost the nuclear warhead to the required range. Today, however, in view of technology's rapid pace, it is necessary to plan far ahead to anticipate what the Air Force should be developing in critical areas such as propulsion, re-entry capability, space maneuverability, rendezvous and other related fields, to obtain answers leading to sufficient capabilty before the absolute need arises.

Head of the Systems Research and Planning Division is Aerospace Vice President J. H. Irving.

Engineering Division

Aerospace's Engineering Division function is to perform the general systems engineering and technical direction of Air Force missiles and space programs which are funded, contracted and generally on the way to demonstration flight tests. General systems engineering and technical direction means that Aerospace does not perform as much detail engineering as did its predecessor technical assistant to the Air Force, Space Technology Labora-

r for USAF

tories, but will depend on the contractor to do more of this detail work. Contractors are more receptive to this approach than they were to the former USAF-Space Technology Laboratories philosophy of more detailed systems engineering and technical direction. Also the general systems engineering and technical direction approach now is more feasible since many of the programs are not as new as those in the ballistic missile and space category of research and development when STL began its technical analysis and supervisory role for the then Ballistic Missile Division.

In totally new areas of research and development, Aerospace will rely on the fact that technical competence has increased so much in the past few years that it will not be necessary for it to perform detailed systems engineering and technical direction.

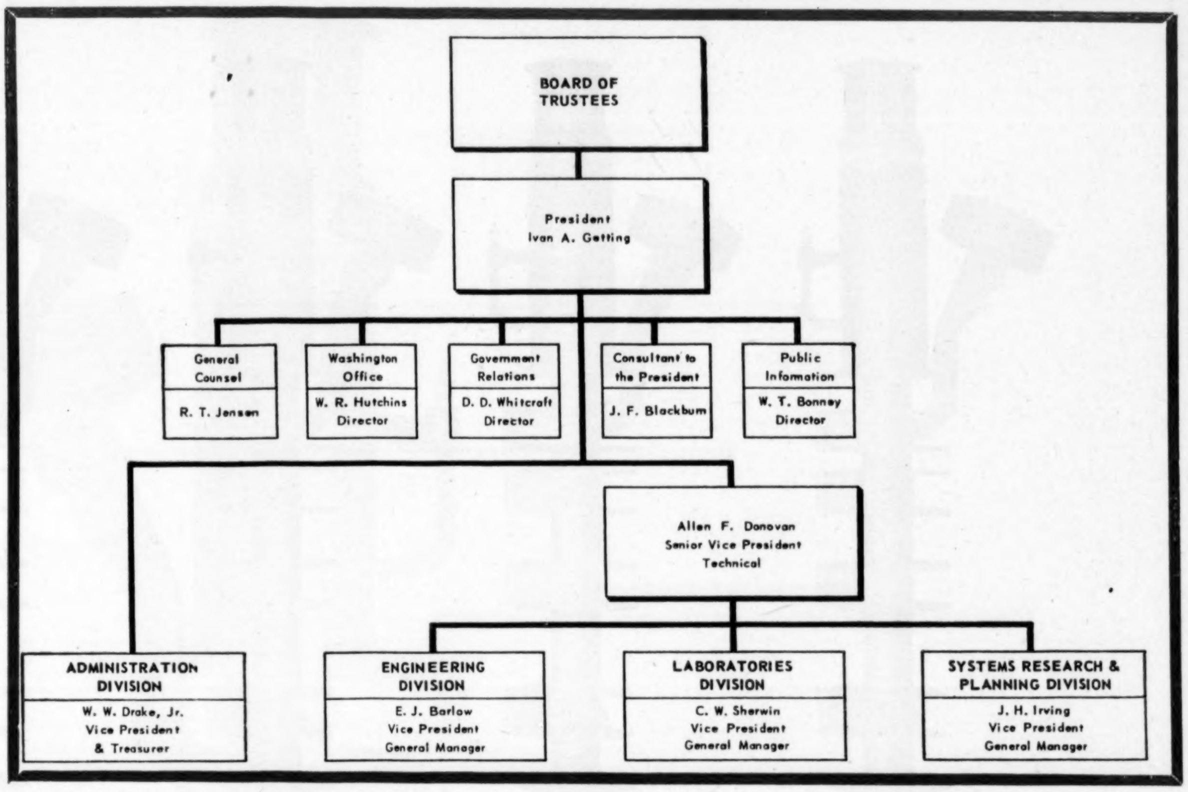
Another function of the Engineering Division is supervision of certain programs which are well along the road and for which Air Force already has a systems manager in charge. Here, the Engineering Division performs a staff advisory role to USAF's Space Systems Division, as on the Lockheed Midas and Samos E-5 programs. In this type of activity, the contractor is not directed, but Aerospace monitors the program to determine if it is progressing properly and will meet its performance requirements, to determine the effect of new technological information or changes in requirements, and to advise the Air Force on what course of action it should take.

Hardware Ban

The hardware ban for Aerospace is relatively absolute. Unless there is a specific exception from the Secretary of the Air Force, Aerospace will not engage in the manufacture of hardware for space and missiles programs.

Engineering Division has general responsibility for these programs:

- **Dyna-Soar booster.** Aerospace's role in Dyna-Soar Step I suborbital mission includes general systems engineering and technical direction for the Martin Titan II booster airframe, General Electric's booster guidance, and Aerojet engines. Air Force's Aeronautical Systems Division has over-all systems responsibility for the Dyna-Soar glide vehicle, for which Boeing is prime contractor. Boeing also has responsibility for the transition section between the booster and the glider.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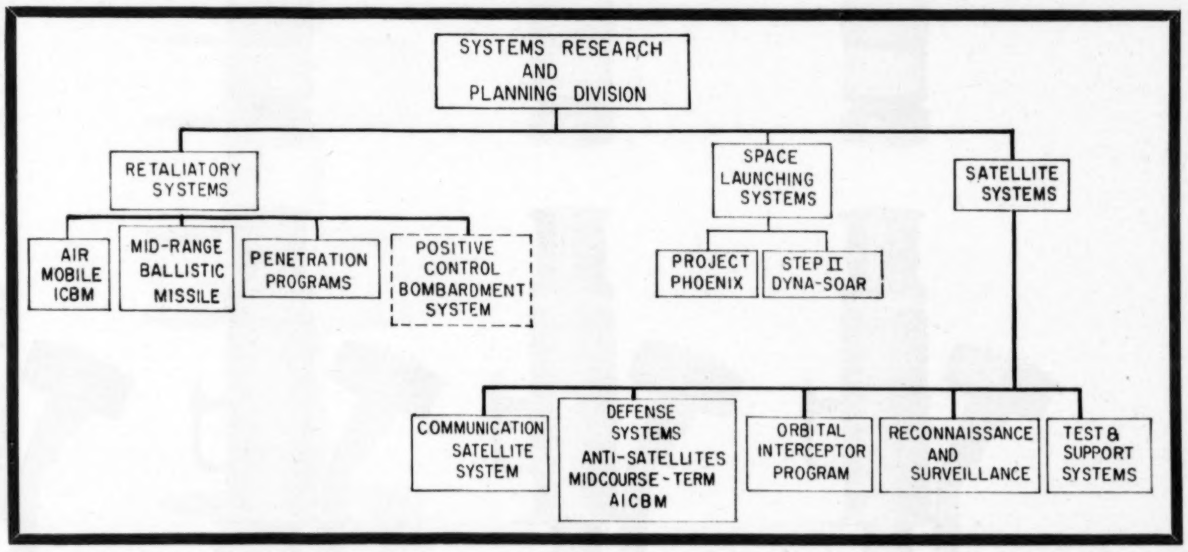
ORGANIZATION CHART shows line of command for Aerospace Corp.'s technical divisions.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MID-RANGE BALLISTIC MISSILE
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SPACE LAUNCHING SYSTEMS
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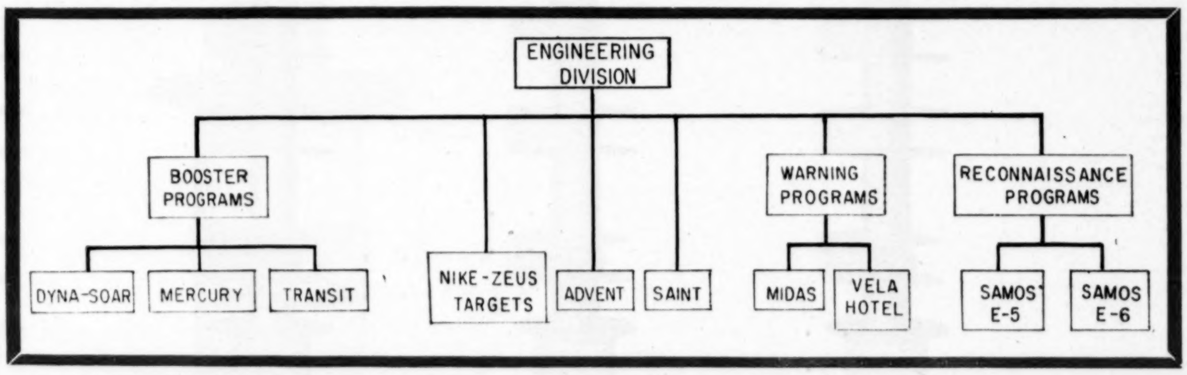
ORBITAL INTERCEPTOR PROGRAM
RECONNAISSANCE AND SURVEILLANCE
TEST & SUPPORT SYSTEMS

PROGRAMS which Systems Research and Planning Division is scrutinizing are shown.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RECONNAISSANCE PROGRAMS
SAMOS E-5
SAMOS E-6

ENGINEERING DIVISION project responsibility is delineated in chart.

Aerospace also is responsible for specified stability parameters of the over-all booster-glider combination, which has required the addition of fins to the base of the booster.

Aerospace also is included in the launch team, as well as Boeing, Air Force and a number of other associated contractors.

General systems engineering and technical direction for Martin's activation of the launch complex for Dyna-Soar at Atlantic Missile Range is another Aerospace responsibility. This is a difficult situation, considering that Martin's broad task here involves the integration of inputs from General Electric (booster guidance), Aerojet (engines), American Machine and Foundry (additional ground handling and launch equipment), Radio Corp. of America (communication and data link equipment), Minneapolis-Honeywell (glider guidance), and Boeing (ground handling and support equipment for its glider).

An example of a potential problem area is the situation in which glider weight and associated transition section would vary, thus requiring additional technical studies for Aerospace to ensure that the new requirements are

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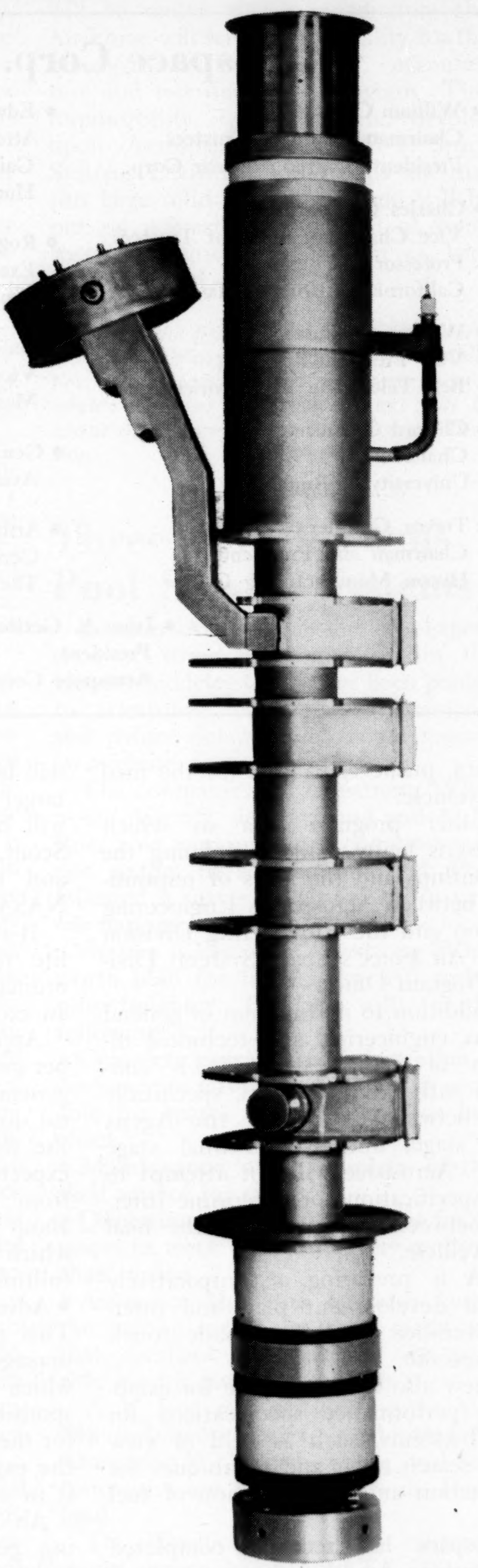

with one.

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within the booster capability for the prescribed mission. Presently, a control weight for Dyna-Soar glider and transition section tentatively has been established by the Configuration Control Committee which is chaired by Aeronautical Systems Division.

Aerospace's work load in the Dyna-Soar project is indicated by the 27 members of the technical staff and five additional staffers supplied by Aerospace support groups, which are involved in the program. This staff may grow to about 46 persons in a year, of which approximately 29 would be in the program office and the other 17 members of the technical staff would be supplied by Aerospace support groups and other departments.

- **Mercury booster.** In addition to responsibility for the Atlas booster in the Mercury program, Aerospace has cognizance of the abort sensing system and for launch and injection of the Mercury capsule into orbit.
- **Transit booster.** Responsibility in this program is for the Thor and Able Star stages, interfaces with the payload, launching, and injection of payload into orbit.
- **Nike Zeus targets.** In this program STL retains detailed systems engineering and technical direction over the Atlas missile, while Aerospace has overall responsibility, in a very general sense, for the entire Nike Zeus target program, and specifically for general systems engineering and technical direction over industrial contractors for reentry bodies, penetration aids, and for miss-distance indicators, depending on the miss-distance indicator techniques used and the extent to which they are assigned to the Air Force or the Army for responsibility. Miss-distance indication will be a difficult technical problem, and definitely will not involve off-the-shelf equipment.

Philosophy of this series of Nike Zeus tests is to do precisely what the Army wants to do to develop and calibrate the Nike Zeus system—all Atlas shots will be to Army specifications. Hence, the tests will include relatively easy defense problems in the early part of the program and progressively work up to more difficult defense situations in the later shots.

- **Saint satellite system.** Aerospace has been involved in this program from its inception. It is the clearest cut program in which it is involved, because it is completely under USAF's Space Systems Division jurisdiction, and no other service is involved.

One of the problems associated with Saint (and other programs, as well) is to arrive at a general acceptable operational definition as to just how much detail Aerospace should encompass in its technical direction. This is being worked out with Radio Corp. of America, prime contractor for the final stage vehicle.

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Another program area in which progress is being made is defining the relationships and the areas of responsibility between Aerospace's Engineering Division and the Engineering Division of the Air Force's Space Systems Division Program Office.

In addition to its function of general systems engineering and technical direction in Saint, Aerospace is concerned with interface areas, specifically those between the Atlas, the Agena upper stage, and RCA's final stage vehicle. Aerospace will not attempt to write specifications or determine interfaces between subsystems in the final stage vehicle.

RCA is preparing a comparatively detailed development plan and interface decisions are being made much more specific.

Review also is being made for establishing performance specifications for the subsystems, such as field of view of the search radar and techniques for construction and pressurization of fuel tanks.

Aerospace has recently completed specifications for the procurement of a target vehicle for the Saint orbital interceptor satellite, which will be issued by Space Systems Division to industry for bidding.

The target satellite will have to be launched about a month before Saint is launched, for proper determination of the target orbital parameters. Aerospace is specifying performance parameters of the Saint final stage vehicle and the target, whch will have to be compatible.

The solid-propellant Scout booster will be the launch vehicle for the Saint target satellite. Probability is that this will be the Air Force version of the Scout, but the decision is not yet final, and there is a possibility that the NASA Scout may be used.

It also is probable that NASA's satellite rendezvous program will be coordinated with the Saint program for an exchange of information.

Approximately 20 to 25 man-months per month are being expended on Saint general systems engineering and technical direction, in which 17 members of the technical staff are engaged. Goal expected to be realized about a year from now for the Saint program is about 55 man-months per month, which probably would involve 20 to 25 fulltime technical staff members.

- **Advent communications satellite.** This program involves a complicated management arrangement. Army, which has over-all management responsibility, has direct responsibility for the communication package and for the experiment itself once the payload is in orbit.

Air Force, with Aerospace performing general systems engineering and technical direction, has responsibility for the booster (an Atlas/Centaur or Atlas/Agena B), the final-stage vehicle, injection of the final-stage vehicle into orbit, and for telemetry, which will monitor experiment components and assist in accurate positioning of the vehicle in the 22,300-mi. synchronous orbit by command signals sent from ground stations to adjust the orbital parameters.

Army has Space Technology Laboratories on its staff as consultant for over-all systems engineering for the Advent program. Feeling is that this function plus the Air Force/Aerospace function in the Advent program creates an overlapping effort which promotes duplication and long channels of technical decision.

Advent program will be spread over a series of shots, in steps, to achieve the ultimate orbital objectives. First experimental shot is likely to be launched at the end of this year or early next year. A very sophisticated performance scheme will be required to put the satellite into the 22,300-mi. synchronous orbit. Probability is that launch will be from a non-equatorial site, for achievement of a relatively low-altitude parking orbit, then into an elliptical transfer orbit to achieve a 22,300-mi. altitude. After this apogee is reached, injection will be made into a 22,300-mi. circular orbit. Data will be taken over a period of days or weeks, followed by adjustment for a precise orbit and period.

- **Midas early warning satellite.** Aerospace has technical supervision of this Lockheed Missiles and Space Division program, as distinguished from general system engineering and technical direction. One of the problems in the Midas type of system development is achievement of reliability for a life in orbit of approximately one year, hence Aerospace is conducting reliability studies. It expects to undertake other important analyses in the over-all Midas program in the near future, such as design studies for a broader-scope system.
- **Samos surveillance system.** In the current E-5 phase of Samos, Lockheed Missiles and Space Division has technical direction, while Aerospace has technical supervision. In the advanced E-6 Samos, which is aimed at intelligence retrieval by re-entry, Aerospace has technical direction responsibility and Lockheed is one of a series of contractors. In the E-6 program, Aerospace is responsible for the system and subsystem specifications, interfaces, development plan, test plan, program realignments resulting from new specifications or requirements, and supervision of the flight test program.
- **Vela Hotel.** Aerospace has general systems engineering and technical direction for this program for monitoring nuclear radiation in space, in which Atomic Energy Commission (Los Alamos Scientific Laboratories and Lawrence Radiation Laboratories) is associated for the design of nuclear radiation detection instrumentation. Program for Vela Hotel is funded and Aerospace will present a development and test plan encompassing orbits, payload weights, responsibility among contractors, and other program details.
- **Large solid-propellant booster** program. While responsibility for all large boosters for achieving lunar landings will be under NASA jurisdiction, the Air Force will have responsibility for the management, development, manufacture and test under the program. This responsibility will, in turn, devolve upon Aerospace and USAF's Space Systems Division. Indications are that this large solid booster program will be put on a crash basis. Head of Aerospace's Engineering Division is Vice President E. J. Barlow.

This is the first of two articles on Aerospace Corp.'s organization and responsibilities. The second article, to appear in next week's issue of Aviation Week, *will be about Aerospace Corp.'s Laboratories Division.*

Three British Firms Pool Service Systems

London—After-sales service experience of three companies within the Hawker Siddeley Group has been pooled to streamline customer requirements and reduce delays which could ground an airplane.

The companies are Armstrong Whitworth Aircraft, de Havilland and A. V. Roe, now working out a common-practice system to achieve this end. Pool followed a survey of customers in various nations.

System is based on Armstrong Whitworth plan for the Argosy 650 turboprop freighter. The plan calls for the following:

- **Complete provisioning information** to customer to ensure that money is available for spares and is spent for best effect.
- **Maintenance of a complete** off-the-shelf service for spares.
- **Quotation of order** lead times for all spares to meet normal delivery and purchase orders.
- **Assurance that the operator** knows the precise source for spare parts and that overhaul arrangements are available for his particular aircraft.

A. V. Roe, now certificating the Avro 748 turboprop carrier, is adopting the Armstrong Whitworth system, and both companies are working with de Havilland.

De Havilland uses the customer spares service based on ATA 200, the specification developed by Air Transport Assn. involving data processing of provisioning cards.

De Havilland has developed a five-day course on major points of the aircraft involved for customer management staffs, in conjunction with its service schools for maintenance personnel.

In addition, de Havilland pilots and flight engineers are available for assignment to the customer airlines for continuing training.

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ON RECORD FLIGHT—

NEW WESTINGHOUSE RADAR HELPS NAVY FIGHTER CUT REFUELING TIME IN HALF

With unerring direction, a Navy F4H-1 jet fighter cently made three high-altitude rendezvous tanker planes between California and New York time was lost in search or lining up for the vital ness of in-flight refueling. The result was a new to-coast flight record of 2 hours, 48 minutes—and

ter endix Trophy. Contributing to the flight was a new s Westinghouse APQ-72 radar aboard the McDonnell ork ghter. With greatly increased range over previous l radars, the APQ-72 located each tanker long before co t was in sight, just as in wartime it would locate an nd nemy target. This precise radar direction helped cut the time for each refueling "stop" about in half. Westinghouse is proud of this demonstration of radar accuracy and the contributions of the APQ-72 to U.S. air strength.—Defense Products Group, 1000 Connecticut Avenue, N.W., Washington 6, D. C.

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J-02336

Grissom Reports on Second MR Flight

The day after USAF Capt. Virgil I. Grissom became the second U.S. astronaut to ride a Mercury capsule into space (AW July 31, p. 30), he met with reporters at Cocoa Beach, Fla., to describe the flight and gave them his reactions. Because this account in Capt. Grissom's own words constitutes an informal "pilot's report" from the third human being to make a flight into space, Aviation Week *is publishing excerpts from the official National Aeronautics and Space Administration transcript.*

Okay, to start with, we might as well start right out with launch, and go through some of the things that I thought were rather interesting in the flight, and, of course, the first thing is lift-off, and the rocket actually lights off and you hear the noise, and you feel the thrust, and the thing starts to move, and the g's gradually build up. The first thing that occurred really I think that would be of interest to all of you is the vibration that occurs at just about 36,000 ft. as we start going through Mach 1. This is the vibration that caused Al a little bit of a problem on his flight. We have changed this capsule some and put in some damping material, and changed some aerodynamic bearings, so that the vibration that I received wasn't nearly as bad as what Al had and although there was some there, it wasn't anything to be concerned about. I could see all my instruments clearly and I could communicate clearly throughout, and so this is one problem I think we have licked. And the next thing that occurred, I was looking out the window. As you all know we have a so-called large picture window that is about like a keyhole to me—it is a big window anyway for a space flight I guess. The next thing, I was looking out the window and there was nothing but blue sky above me. We just passed through one little thin layer of clouds that were still around the Cape, and all of a sudden, or rather rapidly at least, the sky changed from blue to pitch black. It went, just in seconds, from a beautiful blue to a pitch black, and as soon as it turned black, there was a star right in the center of my windshield, and I knew I had lost two steak dinners right then. I guess I will have to pay off tonight, Al, I don't know. But the sky was very black, and things were pretty normal, as you would expect on the launch then, up until the time, well they were normal all the way, but up to the time the escape rocket was fired, which occurs at booster cut-off, I went from six g's down to zero g suddenly. The escape rocket fires at this time, and leaves the capsule, and I heard it go and I saw it go, and the thing went off with two streams of smoke, which came on each side of the window. The escape rocket went off, went off to the right, and I watched it for several seconds. I could see the tail of the rocket with a little light, and saw it keep right on going. With all the speed we had then and all the thrust we had on that rocket I have no idea how far it went, but it really took off, and this was very comforting. This was one of the parts of the flight we were most concerned about, being sure that the rocket leaves, because our recovery parachutes are right under it, we have to get rid of it. This is the first indication that we have really, that the flight is going to go good. When it went off, I really felt good. After the escape rocket leaves there is about a 10 sec. period before the capsule is cut loose from the booster, and this occurred. The clamp ring releases and the posigrades fire; that shoves the capsule away from the booster. There is no doubt when this occurred either—the loud bang. I heard the rockets fire and I felt the push of the rocket pushing me away from the capsule—pushing me away from the rocket, I am sorry. Then the capsule stayed steady for its five seconds for damping, and then it started its turnaround. At this time I was still looking up into the black sky. I couldn't see any more stars; I only saw that one. I was still looking up in the black sky, and it started the turnaround. I could see the sun shining through the window, and I was a little concerned at this time. I was afraid the sun was going to shine, come right in across my face, and possibly blind me, because there was a distinct shaft of light coming in the cockpit and it sort of came around across my suit, but it really didn't get close to my face. Then the horizon came into view, with the earth, and this is the thing that is really fascinating. I don't know how to describe it, but the earth was very bright. At this time I couldn't see any land. I could see the horizon, a very round horizon, and very light wispy cirrus clouds. Then there is a band around the earth, starting with a sort of a light blue at the bottom and fading into a darker blue; there is a very fuzzy edge that is probably going from blue to black, and then very black everywhere—a very black sky all over. There is an even border all around the part of the horizon I could see. The horizon at this time was on the order of 600 mi. to me and a little later it got up to as far as 800 mi., as I reached apogee, and I could see quite a wide arc around the earth.

VIRGIL I. GRISSOM is a test pilot with more than 3,400 flying hr., over 2,500 of them in jets. He was born Apr. 3, 1926, in Mitchell, Ind., and first entered the Air Force in 1944 as an aviation cadet. He was discharged in November, 1945, and was graduated from Purdue University with a mechanical engineering degree in 1950. Grissom rejoined the Air Force and received his wings in 1951. In the Korean war, he flew 100 combat missions in North American F-86s with the 334th Fighter-Interceptor Squadron. He holds the Distinguished Flying Cross and Air Medal with cluster. In October of 1956 he attended the Air Force Flight Test School at Edwards AFB, Calif., and then was assigned as test pilot in the fighter branch at the former Wright Air Development Center in May of 1957. Grissom, shown above, carried a 6-in. dia. mirror attached to the chest of his suit to reflect panel instrument readings to the movie camera mounted above the panel.

I started my pitch and yaw movement to check out the manual control system, and I was so fascinated by this view out the window that I had difficulty concentrating on the instruments. I kept wanting to peek out the window, which is what I did, and I probably didn't do as good a job controlling as I would have liked to. And it was probably because I was dividing my attention between the window and the instruments; maybe there was a slight problem with the control system—it had one nozzle up that was sticking open and this may have caused me some problem, but when we get our telemetry records deciphered, maybe we can determine whether it was me or the control system or both. After the yaw maneuver, the next thing we came to was retro fire. I made a yaw left maneuver to look down the coast of Florida, to the southern tip of Fla., hoping to be able to see Miami, Cuba and maybe the Yucatan Peninsula, but things were quite hazy. The high cirrus clouds obscured most of the land. I did see, evidently, part of the coast of Florida here, just a bit of it, but not enough to identify any portion of it. Al gave me my mark at four minutes

Space Vehicle Log

(As of July 1, 1961)

Satellites in Orbit [1]	Name	Source	Launch	Period	Apogee	Perigee	Transmitting [3]
				Min.	Stat. Mi.		Freq. (m.c.)
1958 Alpha	Explorer I	US	1 Feb. 58	106.6	1120	217	
1958 Beta 2	Vanguard I	US	17 Mar. 58	133.9	2455	404	108.022
1959 Alpha 1	Vanguard II	US	17 Feb. 59	125.4	2052	343	
1959 Delta	Explorer VI	US	7 Aug. 59		Position Uncertain		
1959 Eta	Vanguard III	US	18 Sept. 59	129.8	2318	322	
1959 Mu	Lunik I	USSR	2 Jan. 59	450D	1.3177AU	0.9766AU	
1959 Nu	Pioneer IV	US	3 Mar. 59	398D	1.1421AU	0.9871AU	
1959 Iota 1	Explorer VII	US	13 Oct. 59	101.1	669	344	19.9904
1960 Alpha	Pioneer V	US	11 Mar. 60	311.6D	.9931AU	.8061AU	
1960 Beta 2	Tiros I	US	1 Apr. 60	99.1	467	429	107.997
1960 Gamma 2	Transit 1B	US	13 Apr. 60	95.0	417	229	
1960 Epsilon 1	Sputnik IV	USSR	15 May 60	92.6	322	175	
1960 Zeta 1	Midas II	US	24 May 60	94.3	315	297	
1960 Eta 1	Transit 2A	US	22 June 60	101.6	649	389	162-216-108.06
1960 Eta 2	Greb	US	22 June 60	101.6	657	381	
1960 Iota 1	Echo I	US	12 Aug. 60	117.0	994	934	
1960 Nu 1	Courier 1B	US	4 Oct. 60	106.9	750	604	107.9709
1960 XI 1	Explorer VIII	US	3 Nov. 60	112.6	1412	262	
1960 Pi 1	Tiros II	US	23 Nov. 60	98.2	461	378	108-108.03
1961 Alpha 1	Samos II	US	31 Jan. 61	94.9	342	295	
1961 Gamma 1	Venus Probe	USSR	12 Feb. 61	291D	1.0684AU	0.7104AU	
1961 Delta 1	Explorer IX	US	16 Feb. 61	118.2	1580	430	
1961 Epsilon 1	Discoverer XX	US	17 Feb. 61	94.7	444	176	
1961 Zeta	Discoverer XXI	US	18 Feb. 61	96.6	572	154	
1961 Kappa	Explorer X	US	25 Mar. 61		Position Uncertain		
1961 Lambda 1	Discoverer XXIII	US	8 Apr. 61	93.6	372	183	
1961 Lambda 2	Capsule	US	8 Apr. 61	100.3	828	126	
1961 Nu	Explorer XI	US	27 Apr. 61	107.9	1107	302	108.058
1961 XI	Discoverer XXV	US	16 June 61	90.8	250	139	
1961 Omicron 1 [4]	Transit IV-A	US	28 June 61	104.0	628	557	54-320
1961 Omicron 2 [4]	Greb III	US	28 June 61	104.0	628	557	
1961 Omicron 3 [4]	Injun	US	28 June 61	104.0	628	557	

Object	Decayed Satellite's Name	Source	Launch	Decay
1957 Alpha 2	Sputnik I	USSR	4 Oct. 57	Early Jan. 58
1957 Beta	Sputnik II	USSR	3 Nov. 57	14 Apr. 58
1958 Gamma	Explorer III	US	26 Mar. 58	28 June 58
1958 Delta 2	Sputnik III	USSR	15 May 58	6 Apr. 60
1958 Epsilon	Explorer IV	US	26 July 58	23 Oct. 59
1958 Zeta	Atlas	US	18 Dec. 58	21 Jan. 59
1958 Eta	Pioneer I	US	11 Oct. 58	12 Oct. 58
1958 Theta	Pioneer III	US	6 Dec. 58	7 Dec. 58
1959 Beta	Discoverer I	US	28 Feb. 59	Early Mar. 59
1959 Gamma	Discoverer II	US	13 Apr. 59	26 Apr. 59
1959 Epsilon 1	Discoverer V	US	13 Aug. 59	28 Sept. 59
1959 Epsilon 2	Capsule	US	13 Aug. 59	11 Feb. 61
1959 Zeta	Discoverer VI	US	19 Aug. 59	20 Oct. 59
1959 Theta	Lunik III	USSR	4 Oct. 59	Apr. 60?
1959 Kappa	Discoverer VII	US	7 Nov. 59	26 Nov. 59
1959 Lambda	Discoverer VIII	US	20 Nov. 59	8 Mar. 60
1959 XI	Lunik II (hit moon)	USSR	12 Sept. 59	13 Sept. 59
1960 Delta	Discoverer XI	US	15 Apr. 60	26 Apr. 60
1960 Theta	Discoverer XIII	US	10 Aug. 60	14 Nov. 60
1960 Theta [2]	Capsule	US	10 Aug. 60	11 Aug. 60
1960 Kappa	Discoverer XIV	US	18 Aug. 60	16 Sept. 60
1960 Kappa [2]	Capsule	US	18 Aug. 60	19 Aug. 60
1960 Lambda [2]	Sputnik V	USSR	19 Aug. 60	20 Aug. 60
1960 Mu	Discoverer XV	US	13 Sept. 60	18 Oct. 60
1960 Mu	Capsule	US	13 Sept. 60	15 Sept. 60
1960 Omicron	Discoverer XVII	US	12 Nov. 60	29 Dec. 60
1960 Omicron [2]	Capsule	US	12 Nov. 60	14 Nov. 60
1960 Rho 1	Sputnik VI	USSR	1 Dec. 60	2 Dec. 60
1960 Sigma [2]	Capsule	US	7 Dec. 60	10 Dec. 60
1960 Sigma	Discoverer XVIII	US	7 Dec. 60	2 Apr. 61
1960 Tau	Discoverer XIX	US	20 Dec. 60	23 Jan. 61
1961 Beta 1	Sputnik VII	USSR	4 Feb. 61	26 Feb. 61
1961 Gamma 3	Sputnik VIII	USSR	12 Feb. 61	25 Feb. 61
1961 Eta	Transit 3B & Lofti	US	22 Feb. 61	30 Mar. 61
1961 Theta 1 [2]	Sputnik IX	USSR	9 Mar. 61	9 Mar. 61
1961 Iota 1 [2]	Sputnik X	USSR	25 Mar. 61	25 Mar. 61
1961 Mu 1 [2]	Vostok	USSR	12 Apr. 61	12 Apr. 61
1961 XI [2]	Capsule	US	16 June 61	18 June 61

Notes: 1) Solar satellites have been assigned Greek alphabet designations and orbital elements are given in astronomical units; 2) Successful re-entry and recovery; 3) Frequencies are given only for satellites still transmitting. Estimated lifetimes remain unchanged from the previous Space Vehicle Log (AW Apr. 24, p. 91). Explorer XI has an estimated lifetime of 1-3 yr.; Discoverer XXV, 25 days, and the three Transit satellites, 50 yr.; 4) Initial orbital elements.

Sources: National Aeronautics and Space Administration Space Operations Control Center, North American Air Defense Command (Norad), and Smithsonian Astrophysical Observatory (SAO).

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LIBERTY BELL 7 space capsule moves into position for mating to Redstone booster prior to MR-4 space shot. Retrorocket package can be seen on bottom of capsule heat shield.

and 30 sec. to return to retro attitude and I was having a little bit of difficulty getting back into attitude. It seemed like the capsule was moving slower than I wanted it to move. But we got it back pretty close to the time of retro fire. Al gave me a countdown to retro fire and we fired it manually, and there is no doubt when the retros fire either. Up to this point, I had a distinct feeling that I was actually riding backwards. I am not sure whether this is something that I had built in my mind beforehand, or I was sensing the earth receding, or what it was. I can't define it right now. When the rocket fired there was a very distinct feeling that I had changed direction and was going forward. I intended to look out the window, as I controlled the retro fire. I was looking out the window when the first one fired and I immediately changed my reference to the instruments inside, and this is something else I haven't been able to explain to myself right now. I went from the window, back inside, to the instruments. But I controlled retro fire, and controlled it within limits, pretty well, I think. As soon as the retros were fired, I looked out the window and Cape Canaveral was right in front of me, just as clear as a bell. It seemed like it was a lot closer than it should have been. At this time it really didn't seem like I was a hundred miles up, because the Cape was very distinct. I could see Merritt Island, the Banana River and the Indian River. I could see the Cape and moving on down south of us here; again I was rather fascinated. I went ahead and did the things I was programed to do, such as arming the retrorockets, retro package jettison, switching to rate command control system and switching to HF radio. I switched to HF radio and I tried to report the tremendous view I had, but evidently no one was reading me; at least no one back at the Cape here was reading me; so I switched back to my UHF radio again and started my normal reporting procedures. The retrorocket package had jettisoned right on time, and I glanced down into the periscope just for a few seconds. About this time I saw two of the retrorockets floating around underneath the capsule evidently. I could see them in the periscope. But I never did see the booster as we thought I would. Evidently it was down below me, and I never did get a view of it.

Re-entry Description

About this time the periscope retracted on schedule, and it came time to pitchup to re-entry attitude to get ready to make my re-entry back into the atmosphere. I pitched to my 14 deg. re-entry attitude, and started looking out the window again, to see stars, but I wasn't able to see any again.

The sky was very black. But I think maybe the reason I wasn't able to see any again, was because the sun was shining in from close behind me, and there was an aluminized surface on the base of the window and this was reflecting into the cockpit quite badly.

This might very well have prevented me from seeing any stars.

From there on I went into the re-entry, to the g build-up. I got the .05 g light. We have an indicator that senses five-hundredths of a g, less than a g, which is less than any of us can feel of course. I got this light and knew the re-entry was getting started. I reported that the g's were starting to build, and checked the accelerometer. I only had half a g at this time. I'd been through the weightless period, and I evidently felt the first little increment of g that came on. Then I went back to checking some instruments and looking out the window and the next time I recorded any g's was at six g. Then I called them at six, nine, and on up to 10. I hit about

10.2 g's on re-entry. Then they came off. This was very smooth during this time. No buffeting. There was a loud—at least a recognizable roar. I am not sure how loud it was but a roar that was quite evident, through this phase of the flight. From then on things were again still normal. As I passed through about 65,000 feet—I think it was 65,000—it may have been higher than this, I started seeing contrails out the window. These were white, wispy vapor trails that were coming from the base of the capsule from the heat shield area. These continued for quite some time. Today I talked with one of the pilots on one of the recovery airplanes. He said he could see these contails that started very high, and could see them a long way down. In fact that is the way he spotted the capsule.

The next event that occurred was the drogue chute deployment. I could hear the drogue motor firing and see the drogue pulled right out and blossom. This made me feel real good. I knew with this drogue out that in all probability I was going to get a good main chute. The next thing to worry about was the main chute deployment. As the drogue deployed, a small g built up there. It was just comforting, is about the only way I could describe it. We proceeded rapidly on down to main chute altitude; it deployed at about 11,000 feet, or slightly below, and as the main chute came out, I could see it come out—could see it stream, and see it reef. It comes out in a reefed condition, not a fully opened condition, of course. It sort of divides the shock into two loads, rather than one big shock. I saw it in the reefed condition. I could see all of it. I could see 100% of the chute. I saw the reefing cutters cut the line and the chute blossom out into a full chute then. Through the window I could see about 75% of the chute. Again this was one of the most comforting sights in the flight.

Yes, I knew I was in good shape then. The chute was very nearly perfect. There was one small rip in it—a little triangular rip about six inches on a side and there was one other small hole—I'd guess about the size of a quarter, and this made me feel pretty good. Coming down in the chute then I went ahead and made the normal reports that I planned to make—reading off instruments and giving my condition to a few people that were worried about me—some place or other. As we approached the water, I could see it coming up through the periscope so I was prepared for the landing shock. This wasn't bad at all—a pretty good thump but nothing that would jar me or harm anyone or stun anyone or even daze you. It was just a good solid thump and I was in a good position to take it and that's certainly no problem in the landing.

The capsule tipped sort of on its left side, rolled over on its left side. The parachute compartment cylindrical section on top went completely under the water and out the window all I could see was water. The reserve chute is up in this area and it sort of tends to hold the capsule down. I considered for a minute going ahead and ejecting this. We can switch—by manipulation of a switch, we can get rid of the reserve chute but I decided it was best to wait and see if the capsule would come up a little bit and get this reserve chute out of the water so we could make sure it came

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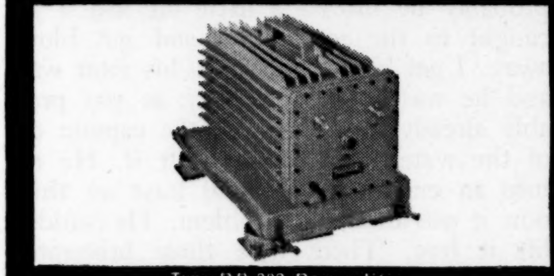
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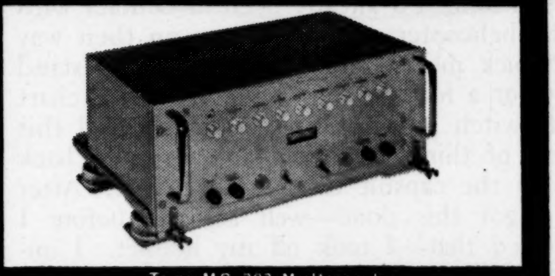
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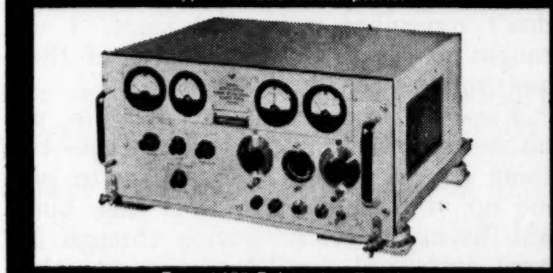
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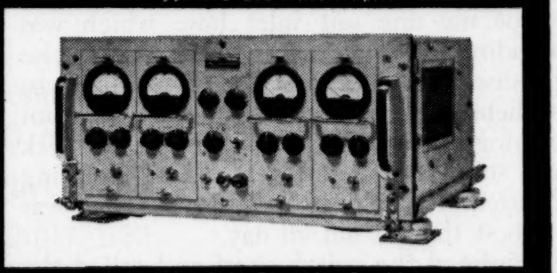
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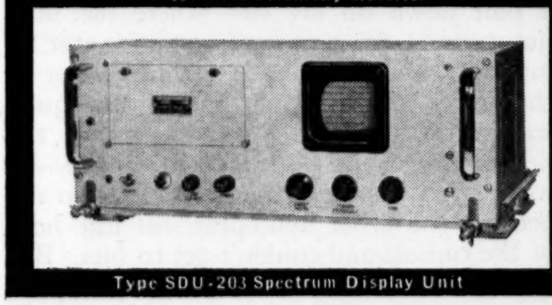
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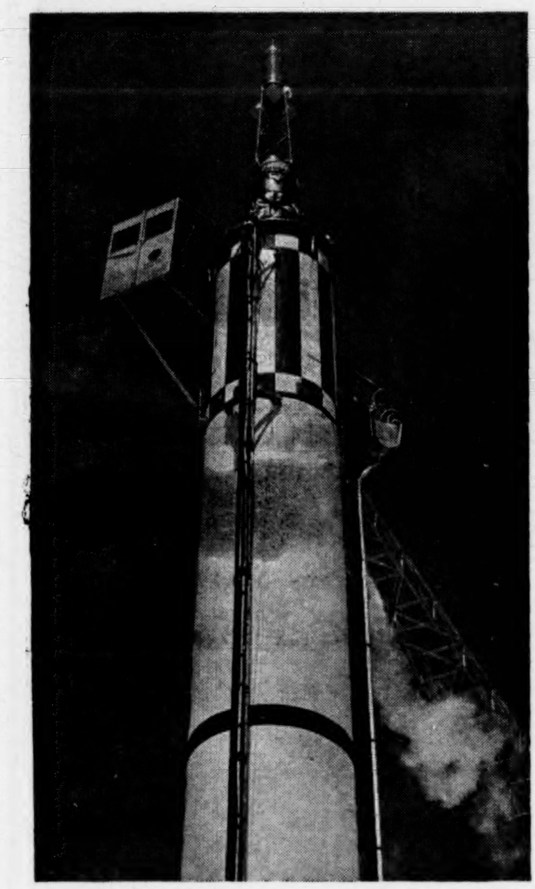


"CHERRYPICKER" escape device adjoins MR-4 capsule during countdown of Redstone booster at Cape Canaveral. Note oxygen boil-off at lower right.

out and it did. It came up very slowly when the window came up out of the water about half way. I decided the tower was pretty well out of the water so I jettisoned the reserve chute and then the capsule came up very rapidly. Within a period of 20 or 30 sec., it righted itself to a vertical position. The wave heights were very small so the capsule was riding pretty comfortable at this time and I felt I was in very good condition. I'd already been in contact with the helicopters and they were on their way to pick me up and I asked them to stand by for a few minutes while I made a chart of switch positions and quantities and this sort of thing that would go right on back with the capsule to the Cape here. After I'd got this done—well actually before I started that—I took off my helmet. I unstrapped myself and disconnected everything except my one suit inlet hose which was providing me with cooling. Everything else was disconnected except the comm leads to the helmet. I disconnected the helmet from the ring on the suit and rolled up the neck dam so that if I did get out, if anything occurred, I would at least float. That was the best thing I did all day.

I finished the switch chart and called the helicopter and told him I was ready to come out, and as soon as he had hold of the capsule and was ready for me to come out, to give me a call. At that time I would power down the capsule, take off my helmet, and blow the hatch.

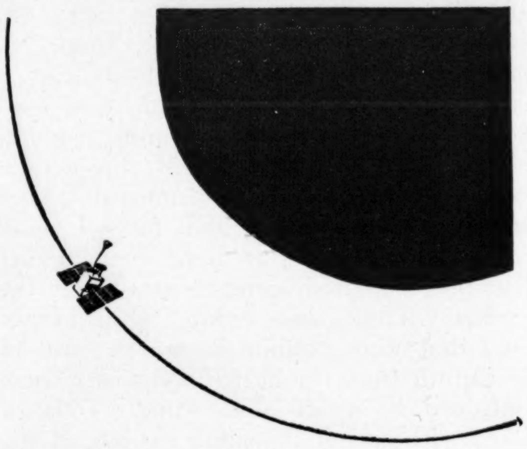
While he was coming in, I decided to go ahead and get a little head start on him, and took off the cover on the detonator that blows the explosive hatch off and tossed it down toward my feet. I then pulled the safety pin that holds the detonator out. You have to pull it before you can fire it. So then I was all set and waiting for him, and laid back down on the couch, and he gave me a call and said he was on final and I knew that he would pick me up in 10 or 15 sec. I was just laying there minding my own business, and Pow!—the hatch went. I looked up and I saw nothing but blue sky and water starting to come in over the sill. So I tossed my helmet off. The only two moves I remember making were tossing my helmet off and grabbing the instrument panel; I don't remember going out the door. The copter pilot said the door came off, immediately followed by myself, almost one motion. Without a doubt that was the biggest shock all day, to me—to see that door go off. I went into the water. Luckily I had the neck dam up. I felt I was in pretty good shape. I was floating quite high in the water, about armpit high, because the suit does float quite well in the water, with the neck dam on. I saw the helicopter there, very close. He had already cut the antenna. The antenna was gone and he was grappling for the loop on top of the capsule, and it was sinking rather rapidly. It looked like to me he was having difficulty getting hold of it, but actually I guess he wasn't. This was the first time he had tried to snag it. So I clambered over to the capsule which was only four or five feet away and was going to maybe help him put the hook on it, but before I got there he actually had it hooked.

Engine Trouble

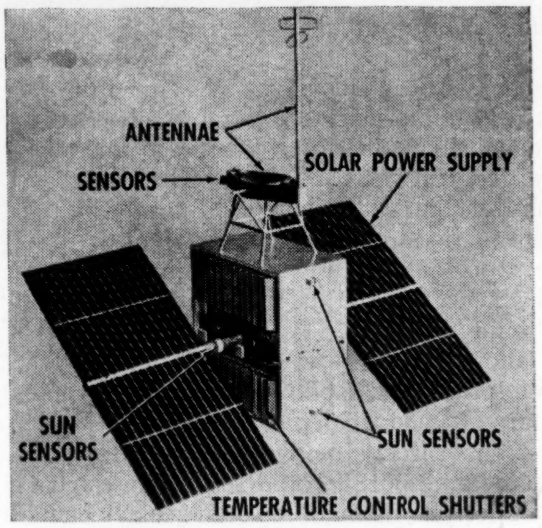
I saw him lift his pole, and the hook was on, and the hook dropped off the pole, which is normal, but at this time it did not look very normal to me, and I thought "Oh, he lost it again." The capsule actually sank and went below the water. The helicopter pulled it free, and as he pulled it up, I thought, "Well, we are in good shape again, we have got it all, and he would pick me up as soon as it gets free of the water."

The helicopter moved on away slightly; probably he moved a little bit and I got caught in the rotor wash and got blown away. I got blown outside of his rotor wash and he was having difficulty, as you probably already heard, getting the capsule out of the water. He couldn't lift it. He ran into an engine problem; at least we think now it was an engine problem. He couldn't lift it free. There were three helicopters there. I guess actually there were four—I don't remember seeing but three. I was caught in the center of all three of them and couldn't get to any of them.

I saw the second helicopter move in, put his horse collar down to pick me up—this thing hanging down in the water to pick me up. I tried to get over to him, but I was having difficulty getting through his rotor wash, and also I'd neglected to close a port down on my suit, where the inlet hose comes in, and was getting water in my suit. I was getting lower and lower in the water all the time, and it was quite hard to stay afloat. But eventually, the helicopter got in close enough to me—he was having trouble getting any closer to me because the other helicopter still had hold of the capsule and couldn't get to him. But some way or other the Marine copter pilot did get in close enough for me to get hold of the sling, and everything was pretty good for me from then on. They picked me right out of it and got me onto the USS Randolph, of course.



ADVENT



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Tracking and Command to provide position and orbit information.

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Attitude Control to orient ADVENT's solar cell paddles toward the sun and its antennae toward the Earth.

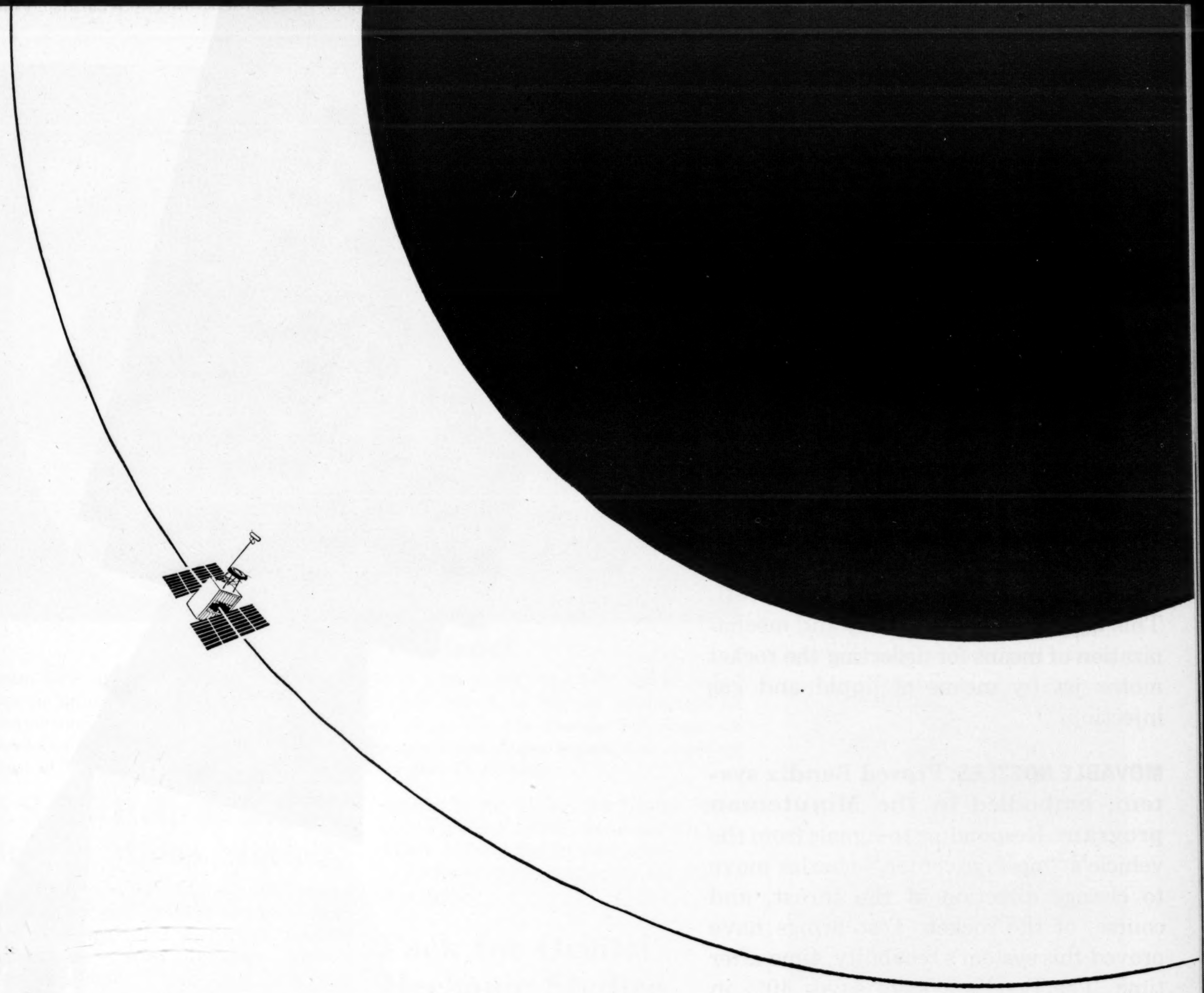
Environmental Control to keep equipment operating at the stable temperature necessary to fulfill the long-life requirements.

Telemetry to provide continuous transmission of data on equipment performance.

MSVD, a department of the General Electric Defense Electronics Division, is developing the space craft for the U.S. Army ADVENT Program under a contract with the USAF Space Systems Division.

160-02

GENERAL ELECTRIC



ADVENT is designed to be America's most advanced military communications system. Three active repeater satellites, orbiting at 22,300 miles in space, can provide instantaneous communications among U.S. government activities throughout the world. To help prove overall system feasibility, General Electric's Missile and Space Vehicle Department is developing the ADVENT space craft for the U.S. Army, under the direction of the U.S. Air Force.

GENERAL ELECTRIC

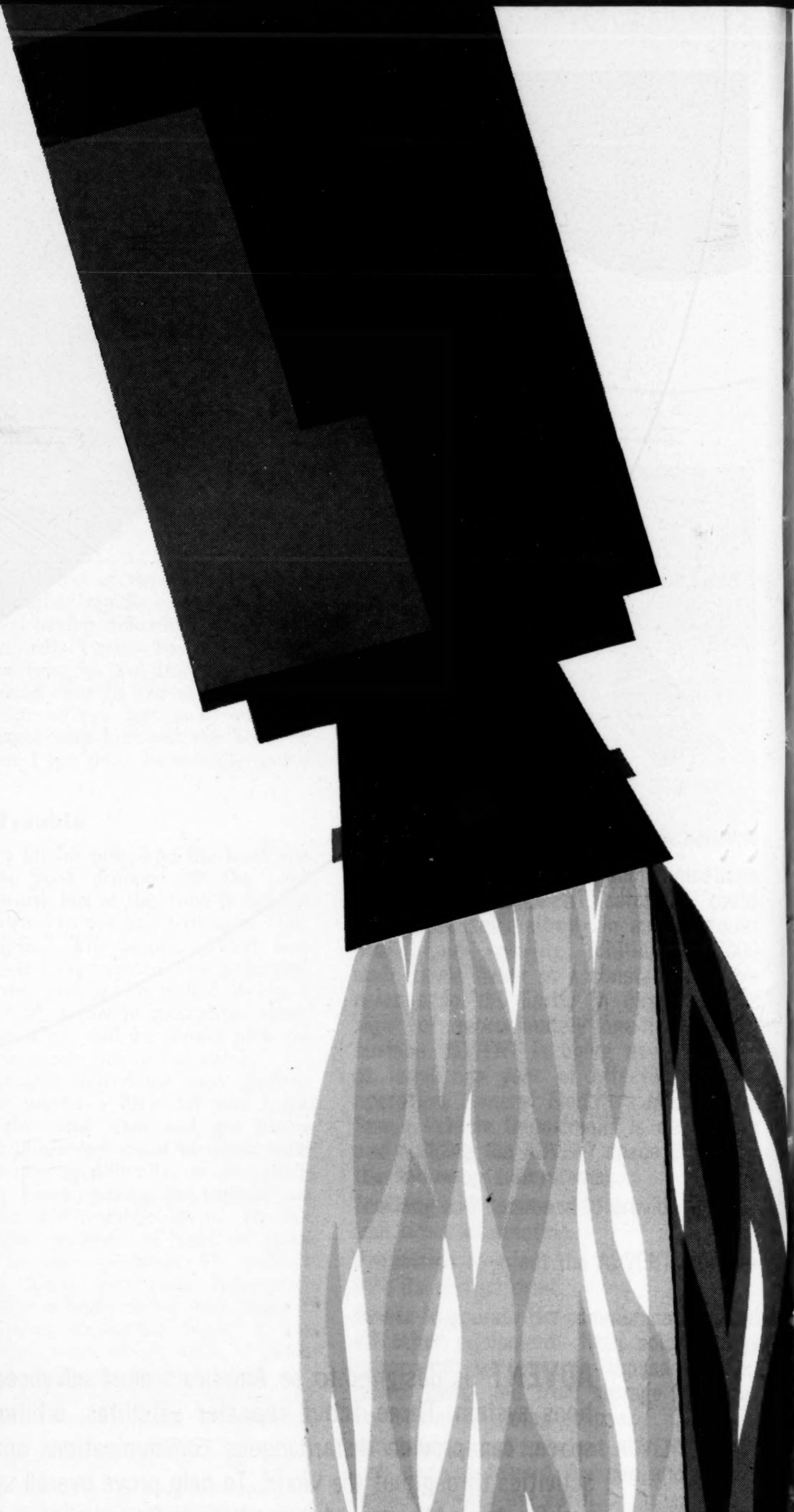
MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.

STEERING GEAR FOR OUTER SPACE:

BENDIX THRUST VECTOR CONTROL SYSTEMS

SECONDARY INJECTION: Newest way to "call the turns" in outer space. Bendix is now heavily engaged in research and development work on systems to steer Polaris and other missiles and spacecraft. This work involves the study and mechanization of means for deflecting the rocket motor jet by means of liquid and gas injection.

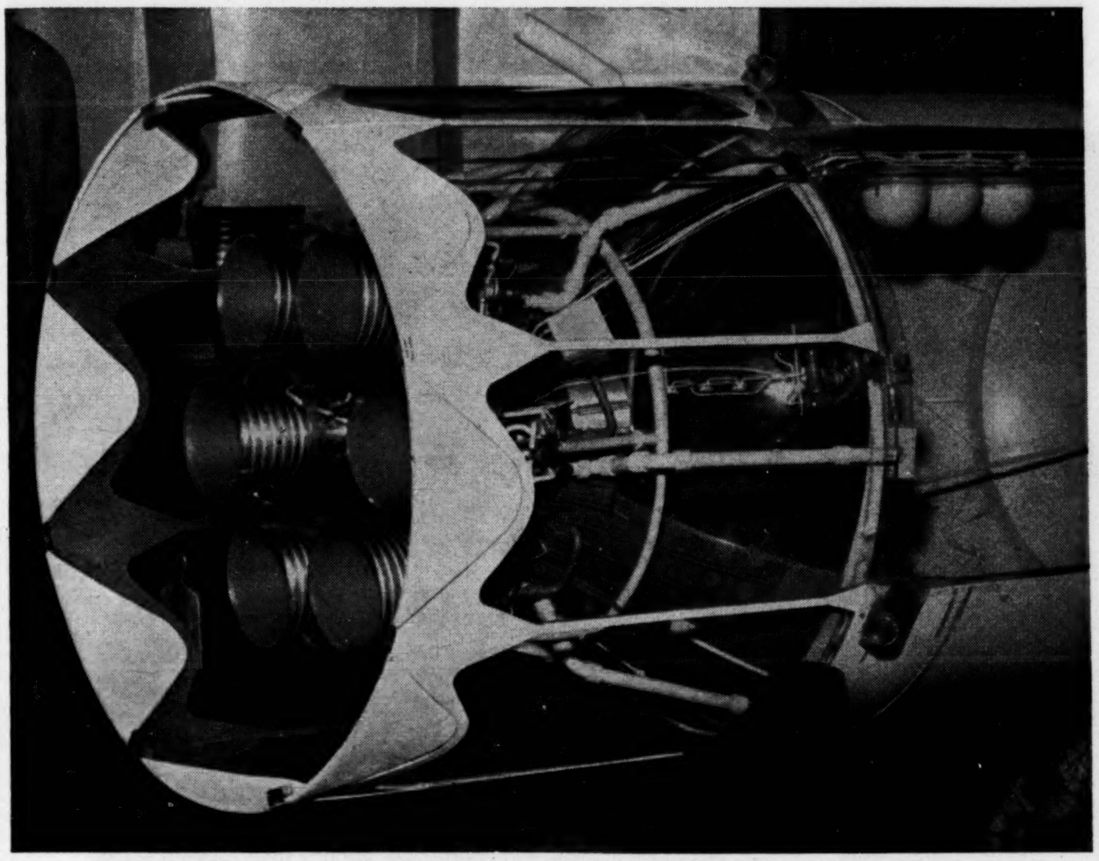
MOVABLE NOZZLES: Proved Bendix system, embodied in the Minuteman program. Responding to signals from the vehicle's "message center," nozzles move to change direction of the thrust, and course, of the rocket. Test firings have proved this system's reliability, time after time. The Bendix system saves 40% in weight compared with previous test systems, and has low actuation torque requirements.



Qualified contractors are invited to write for further information. Write: Bendix Products Division—Aviation, South Bend 20, Indiana.

Bendix PRODUCTS DIVISION South Bend, IND.

THE Bendix CORPORATION



Saturn S-IV Model

Saturn S-IV stage's nozzle arrangement is shown in scale model. The S-IV will be second stage in Saturn C-1, third stage in Saturn C-2 (AW May 8, p. 58) and is projected for incorporation in Nova space vehicles (AW June 19, p. 32). The Douglas S-IV stage will contain six Pratt & Whitney LR-115 liquid hydrogen/liquid oxygen engines with combined thrust of 90,000 lb. Stage IV will be 220 in. in dia., 33 ft. long.

U.S. to Help Finance British Midas Station

London—United States will spend $28 million and provide technical help and equipment for a British readout station tied in with the Midas satellite warning system.

Julian Amery, British secretary of state for air, said the station will be manned by the Royal Air Force at Kirkbride, Cumberland, and will be complementary to the BMEWS station now under construction at Fylingdales. United Kingdom will contribute from $5 to $8 million toward the project besides providing the station, which has been unused for some time. It is near the town of Carlisle.

Amery said the station, which will be connected with NATO and RAF Bomber Command, will give about 6 min. warning of ballistic missile attack, against 4 min. for BMEWS. He declined to say when it would be operational but noted that a primary value will be in detecting missiles fired from submarines or surface vessels from any sea point in the world.

Equipment at RAF-Kirkbride, which will be installed by the United States, includes three 100-ft.-dia. radomes. The station will be jointly manned by U. S. Air Force and RAF until operational date when RAF will take over the entire station.

Amery said warning signals will be available simultaneously to operational centers in the U. K., the United States and supreme allied command-Europe. Work is expected to start soon.

Parliamentary reaction to the station was mild.

Pack for Orbital Mechanic Studied

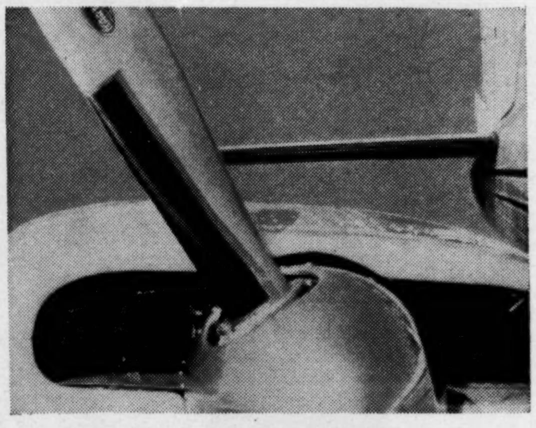
Dallas, Tex.—Design study contract award of $58,000 for a small self-maneuvering back-pack propulsion system that would enable orbital mechanics to maneuver about in space, stabilize them while they are working or permit them to act as tugs to maneuver vehicle assemblies into position, has been granted Chance Vought Corp.'s Astronautics Division by the USAF Aeronautical Systems Division, Wright Patterson AFB, Ohio.

Design of the "Spacemanpack," as it is termed by Chance Vought, will permit attachment to current full-pressure suits or capsule-like rigid suits having remotely controlled manipulator arms. For stabilizing the user, Vought is studying manual and automatic systems with torque provided by gyroscopes, inertia wheels and gas jets. In terms of propulsion they are considering gas-liquid and solid propellant types, in addition to the possibility of a dual-purpose system such as one using oxygen for propulsion and breathing.

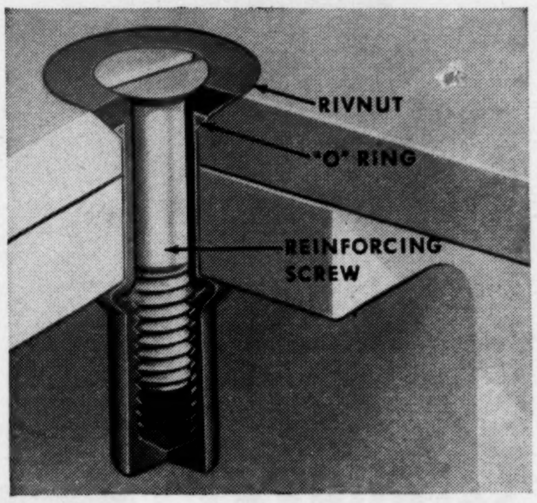
Chance Vought engineers by next year expect to devise a wood and plastic mockup of a space back-pack.

Ideas you can use from

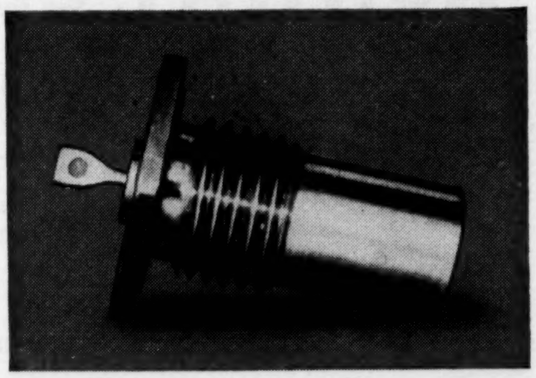
B.F.Goodrich



POSITIVE ICE PROTECTION. New Electrical Propeller De-Icers available and qualified for light twin-engine aircraft. Complete kit weighs only 10 pounds. Electrical heating always reliable; eliminates frequent servicing required with liquid systems.

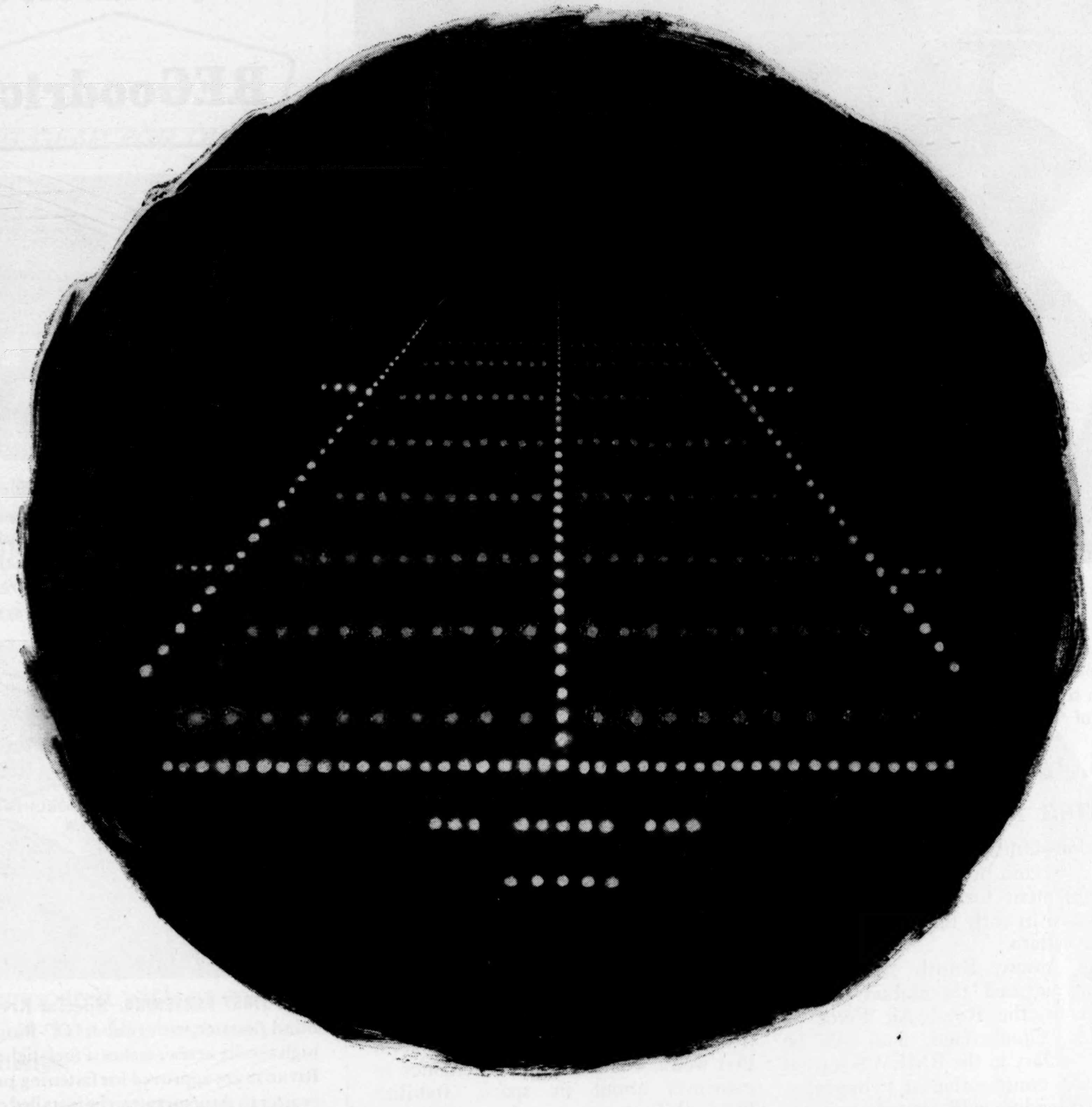


FUEL-TIGHT FASTENING. Special RIVNUT® blind fastener, with rubber "O"-Ring and high tensile screw, makes a fuel-tight seal. RIVNUTS are approved for fastening primary aircraft structures; can be installed quickly by one man from one side of the work.



FEATHERWEIGHT PRESSURE INDICATION. High pressures in engines, batteries, etc., can be indicated with this tiny, sensitive device. Contact is closed by a bellows at preset pressure, in range of 250 to 500 psi.

For more information check your B.F.Goodrich Aviation Representative, or write *Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-8A, Akron, Ohio.*



RUNWAY CLEAR...AT FORTY FATHOMS

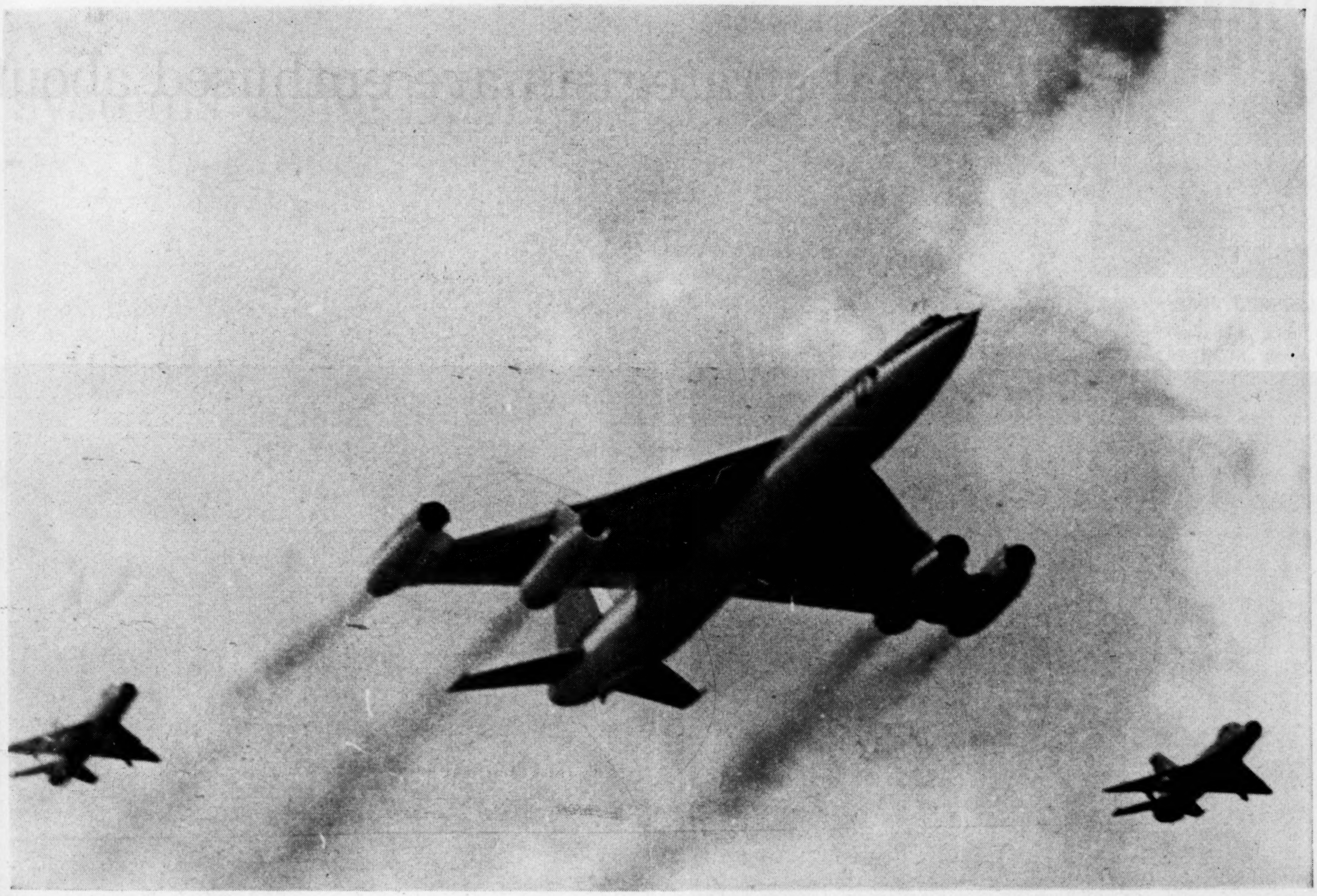
Just as runway lights establish the boundaries of a landing strip at night ... and the pilot relies on electronic eyes to see through clouds and darkness ... submarines can be fully oriented to the dim depths of the sea by a continuous set of signals. Norden's contact analog display in the submarine's control room reveals on a single screen every key parameter: pitch, roll, heading, surface and bottom positions. This sophisticated system utilizing advanced television and computer techniques, was developed for the Navy's Bureau of Ships ... from concept to hardware in less than 18 months. With minor modifications, the display is applicable to aircraft.

This is just one of several important programs at Norden involving advanced television, radar, digital computing, and digital control systems. The contact analog display, pointing out the runway beneath the sea, demonstrates Norden's primary mission, EXTENDING MAN'S CAPABILITIES.

NORDEN division of UNITED AIRCRAFT CORPORATION

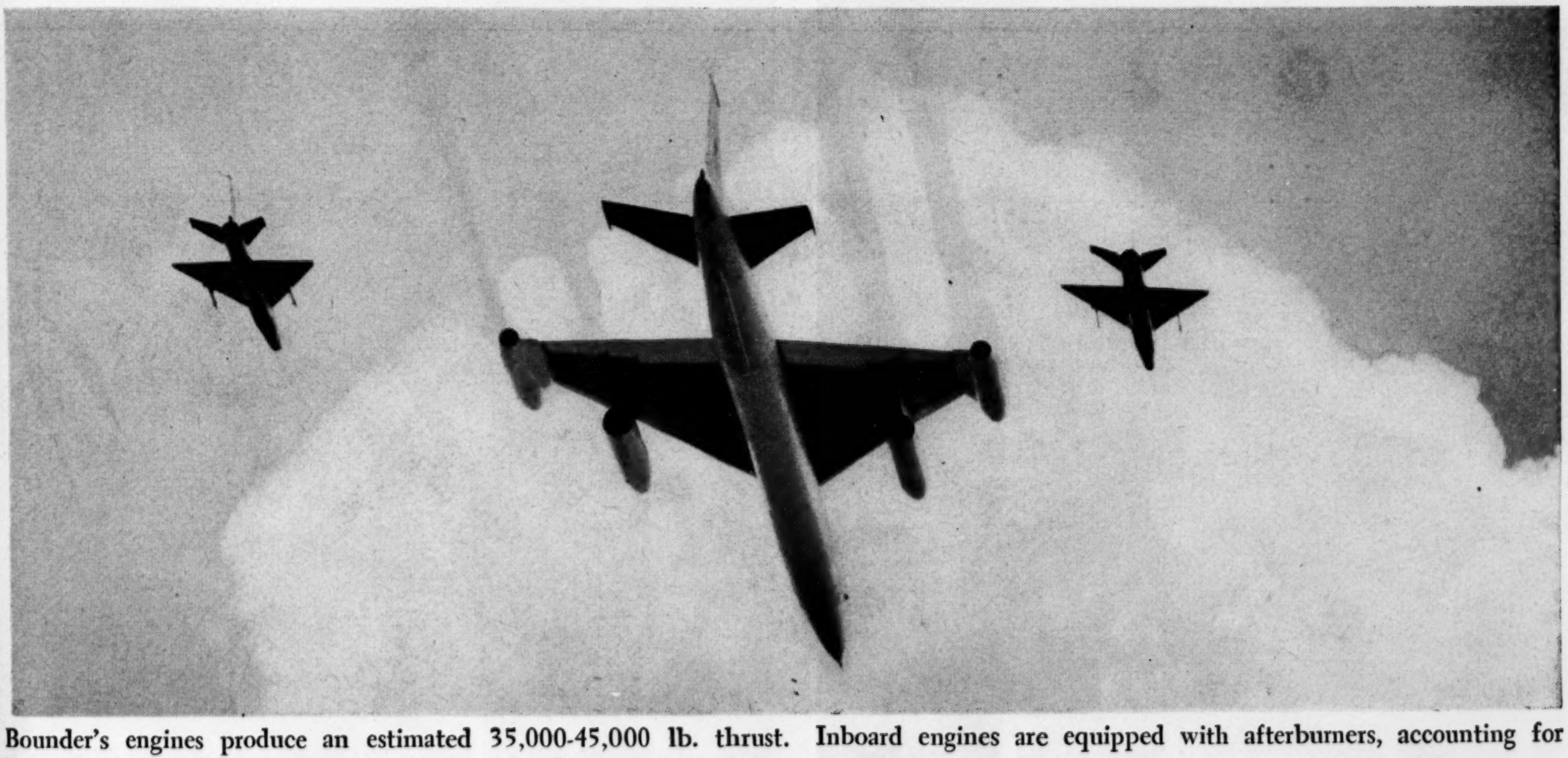
NORWALK, CONNECTICUT

AERONAUTICAL ENGINEERING



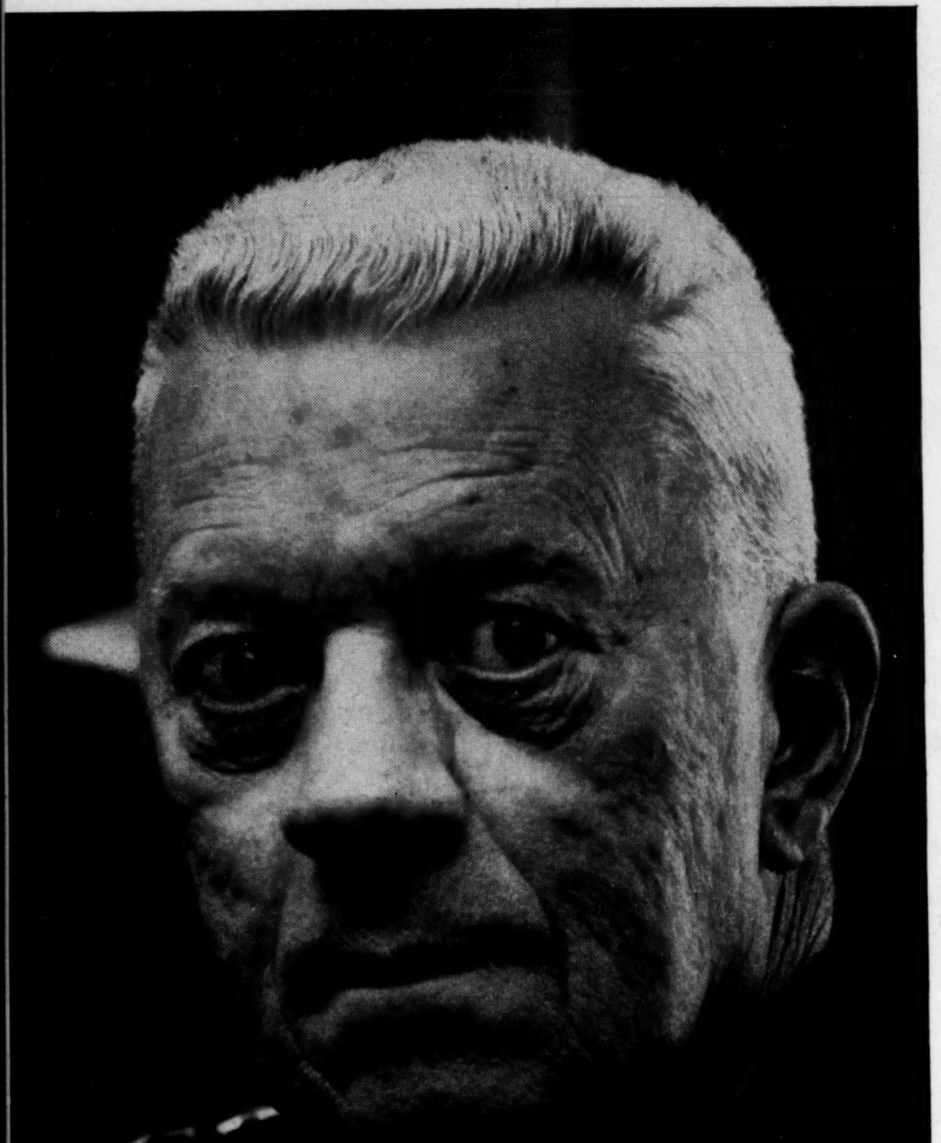
Russian Bounder heavy intercontinental bomber, escorted by two Fishbed fighters in Tushino rehearsals (AW July 17, p. 26), has an estimated Mach .9 cruise speed capability and Mach 1.4 dash capability. See pp. 72, 73 for additional photos.

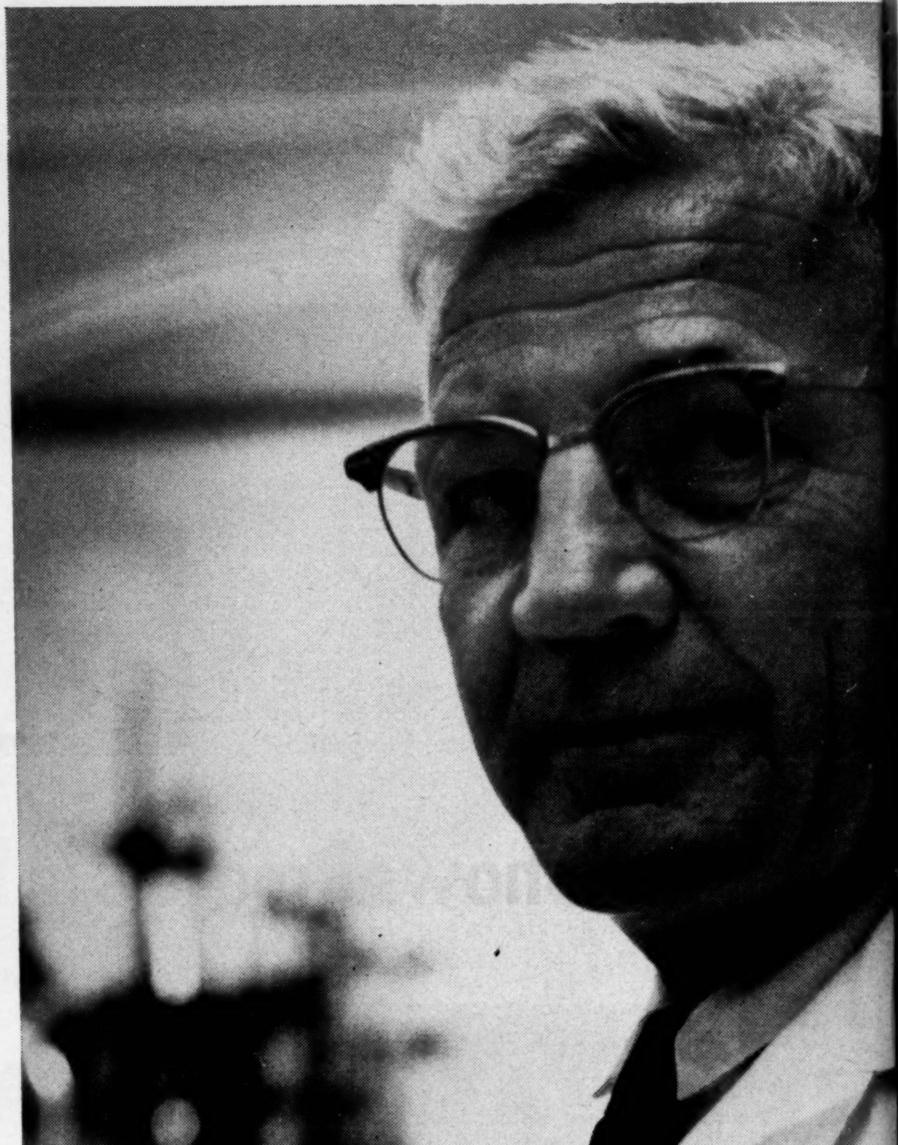
Bounder Shows Progress in Russian Design Capabilities



Bounder's engines produce an estimated 35,000-45,000 lb. thrust. Inboard engines are equipped with afterburners, accounting for larger diameter tailpipes. Flaps are constant chord, ailerons constant percentage.

Almost all global strategists are enthused about





systems using Sperry electronic tubes

SPERRY
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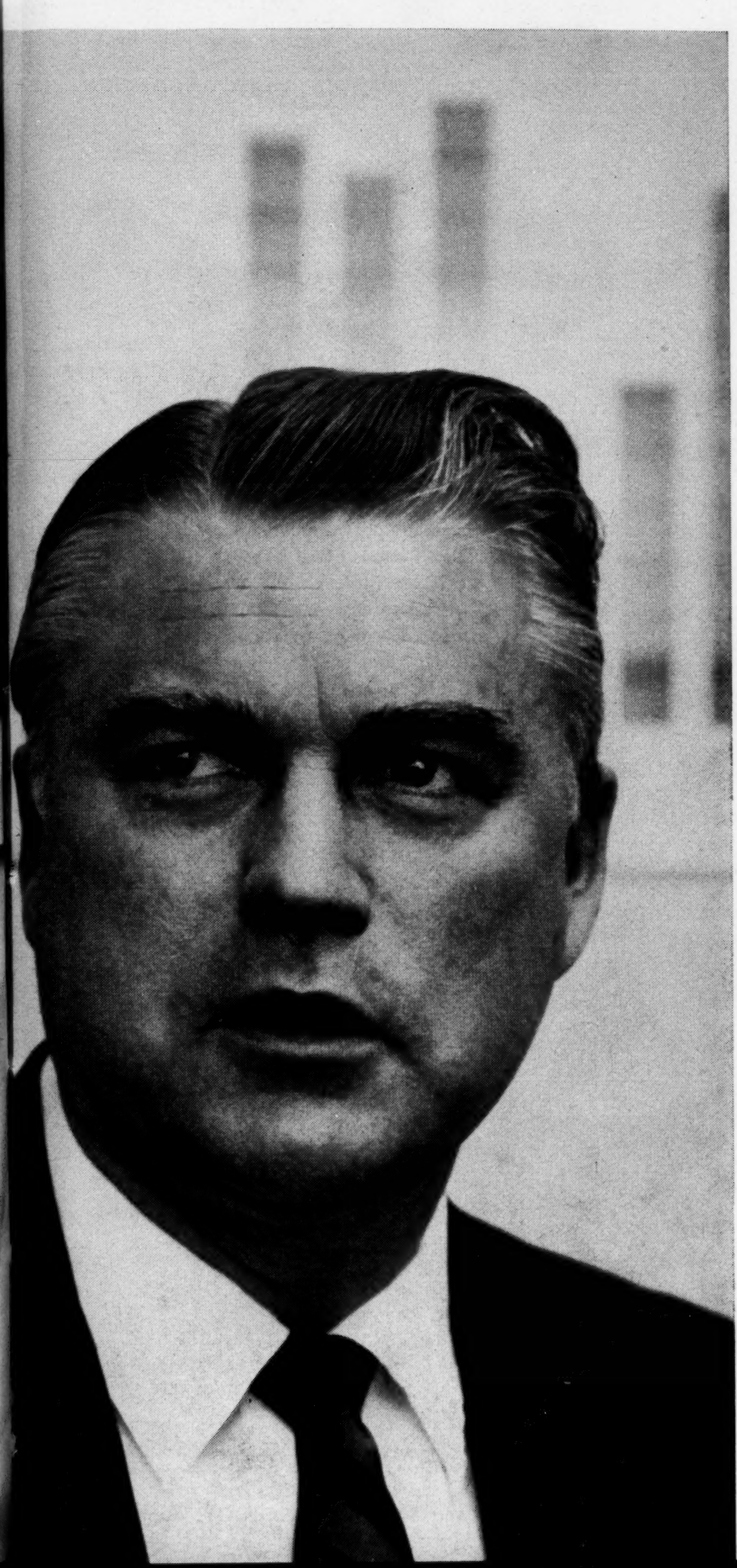
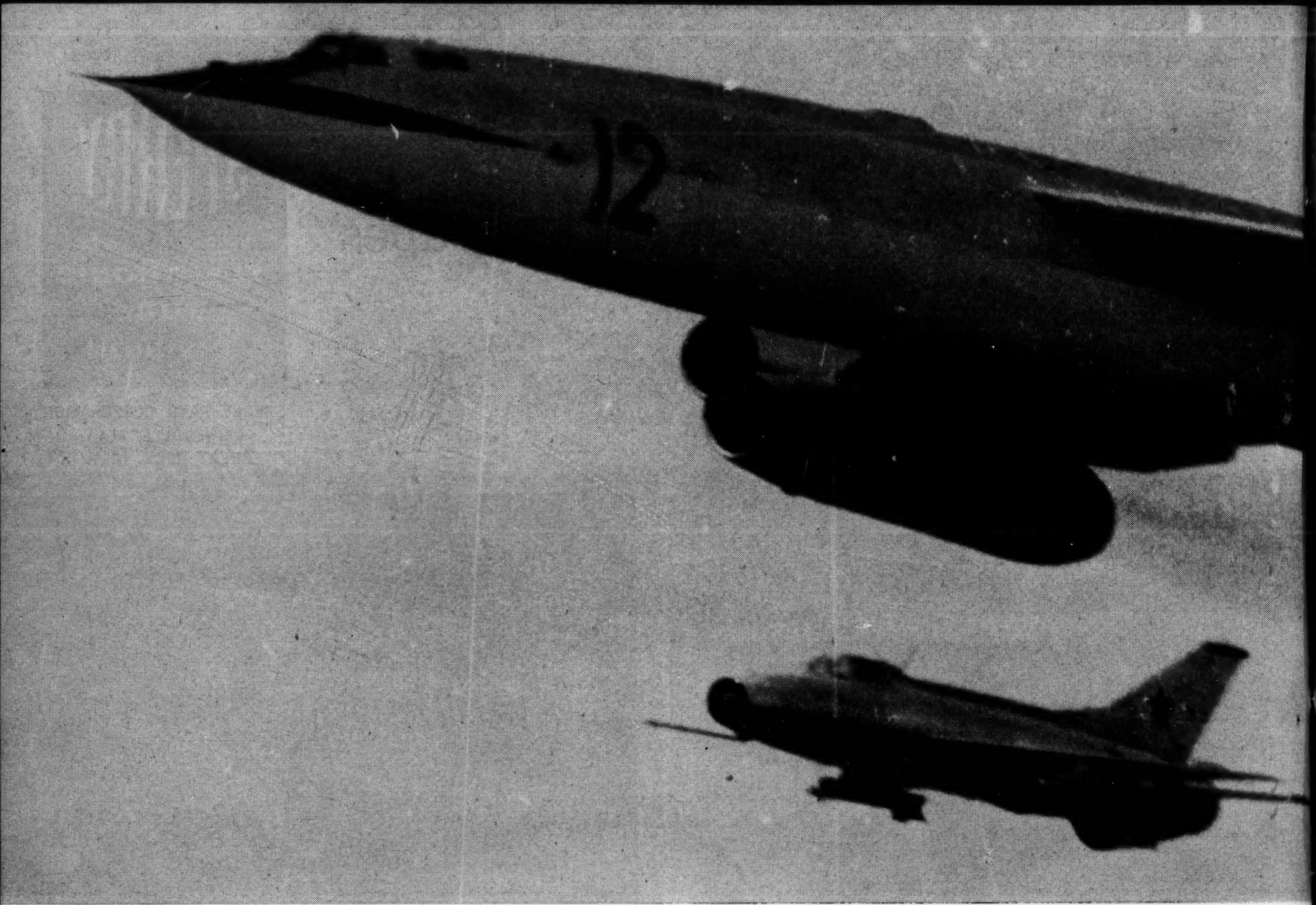
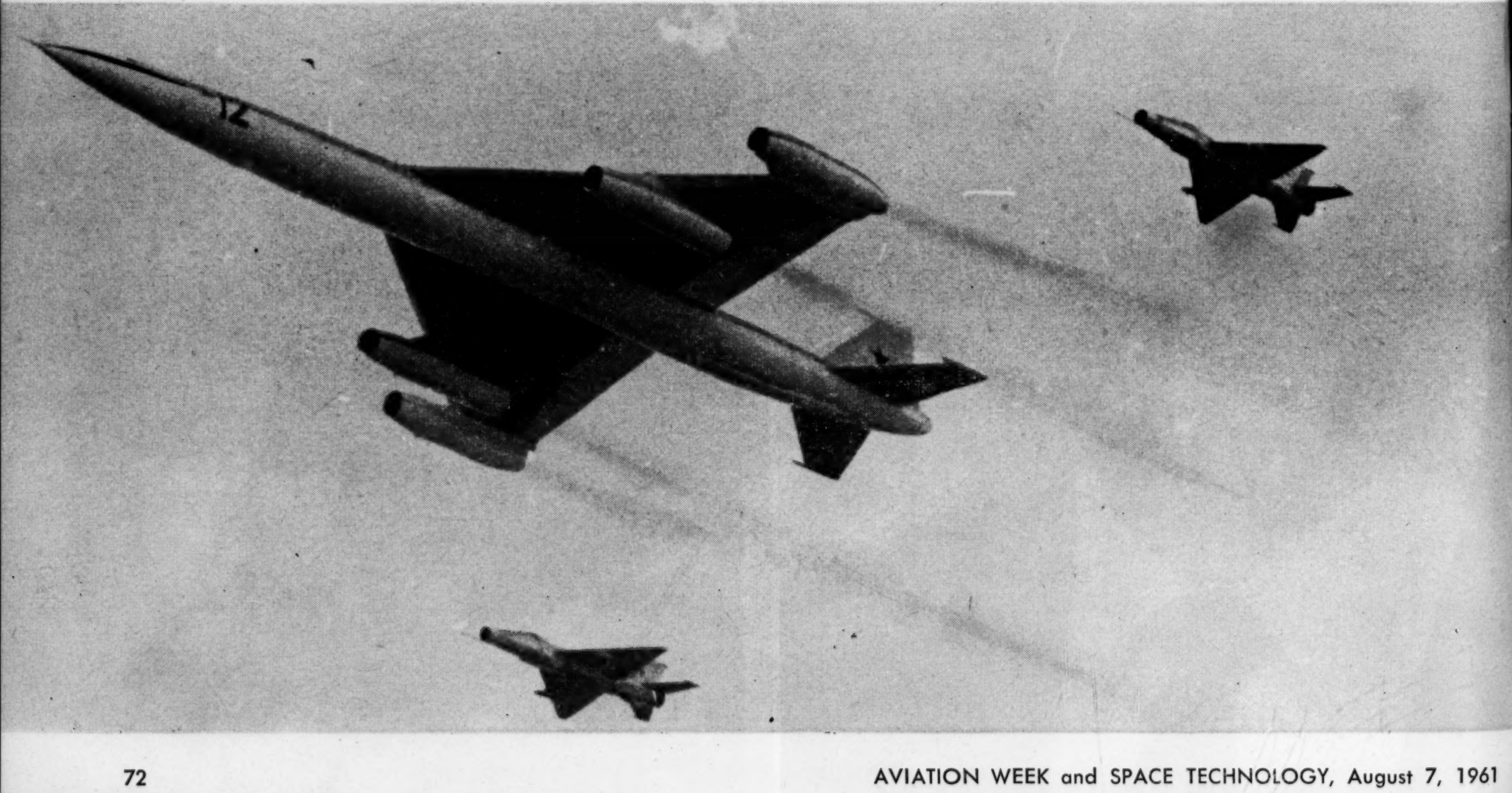
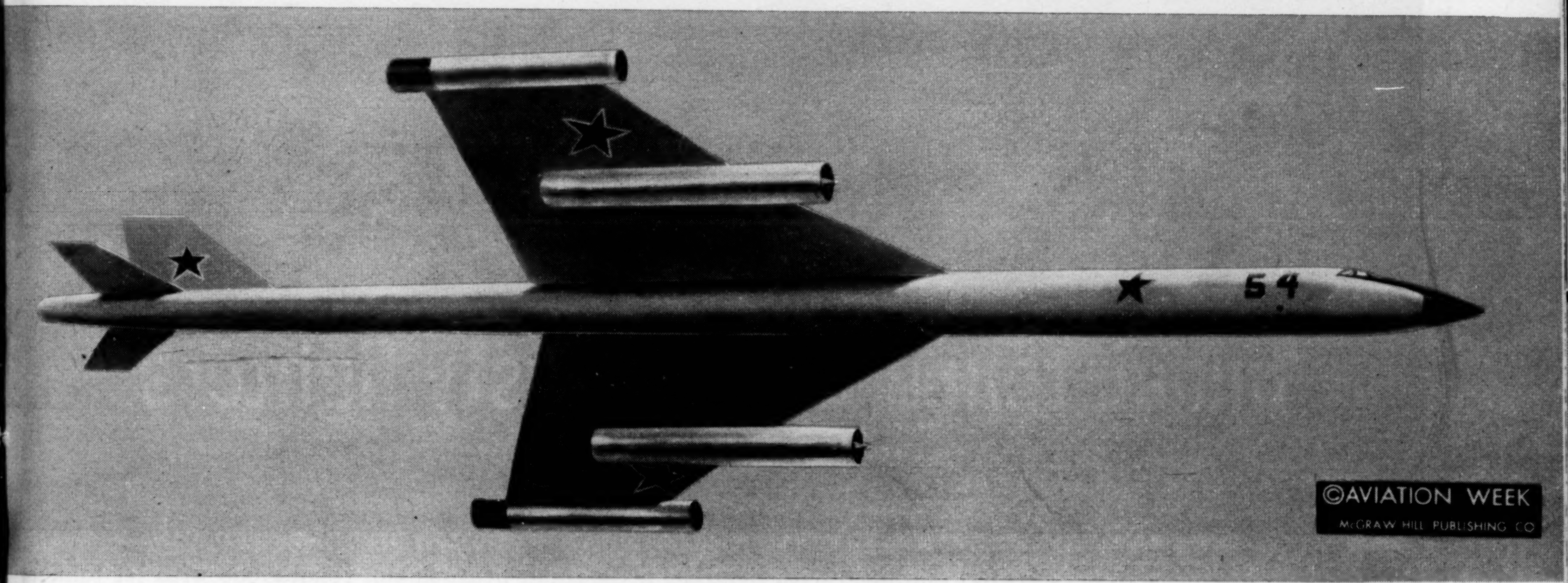




Soviet Bounder heavy bomber may also have capability as an aerial tanker for refueling several Beauty bombers (AW July 24, p. 26; July 17, p. 26). Fairing on belly ahead of the tail may be housing for boom. Optical plate, possibly for boom operator, is visible at the end of the fairing (see bottom photo, p. 73). Heavy fairings for engines at the tips of the modified 45-deg. swept delta wing serve in addition as housing for outrigger landing gear. Main bicycle gear is housed fore and aft of the wing, and the forward section is longer, giving Bounder a nose high attitude on the ground. A 40-ft. bomb bay is fitted between the gear housings, and two scoops or racks are visible on the fuselage near the wing root at this point. Wing aspect ratio is on the order of 2.5. Engine nacelle diameter is estimated at 6 ft. Aviation Week drawing, published Dec. 1, 1958, (p. 26) and based on early information shows many similarities to Bounder (center, p. 73). Bounder is painted light, possibly with anti-radiation paint on belly, nacelle undersides.

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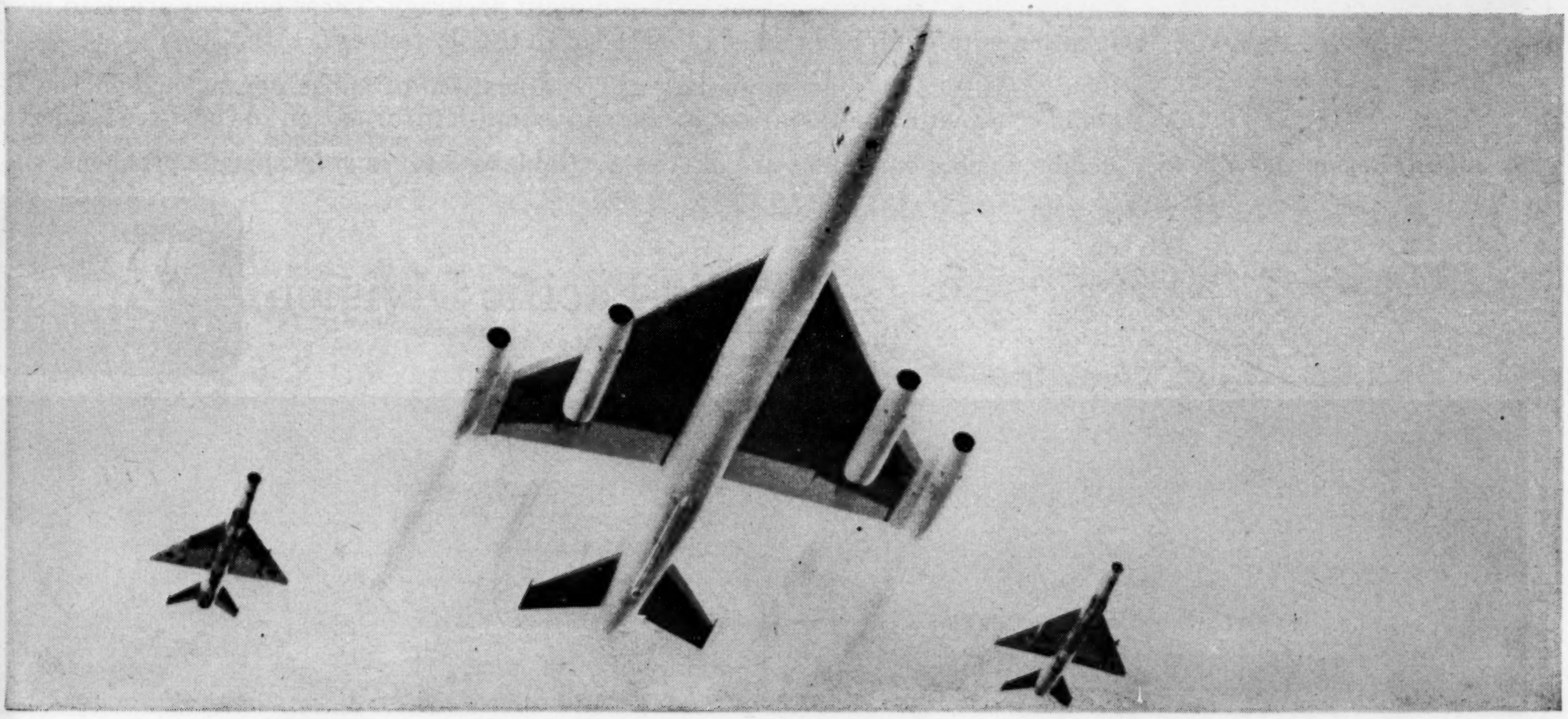
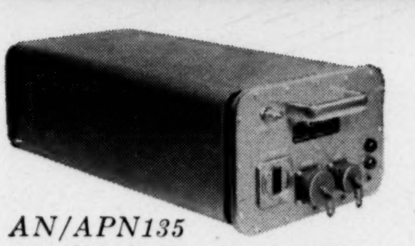


midair round-up for thirsty fighters


AN/APN135
(modified) Rendezvous Beacon

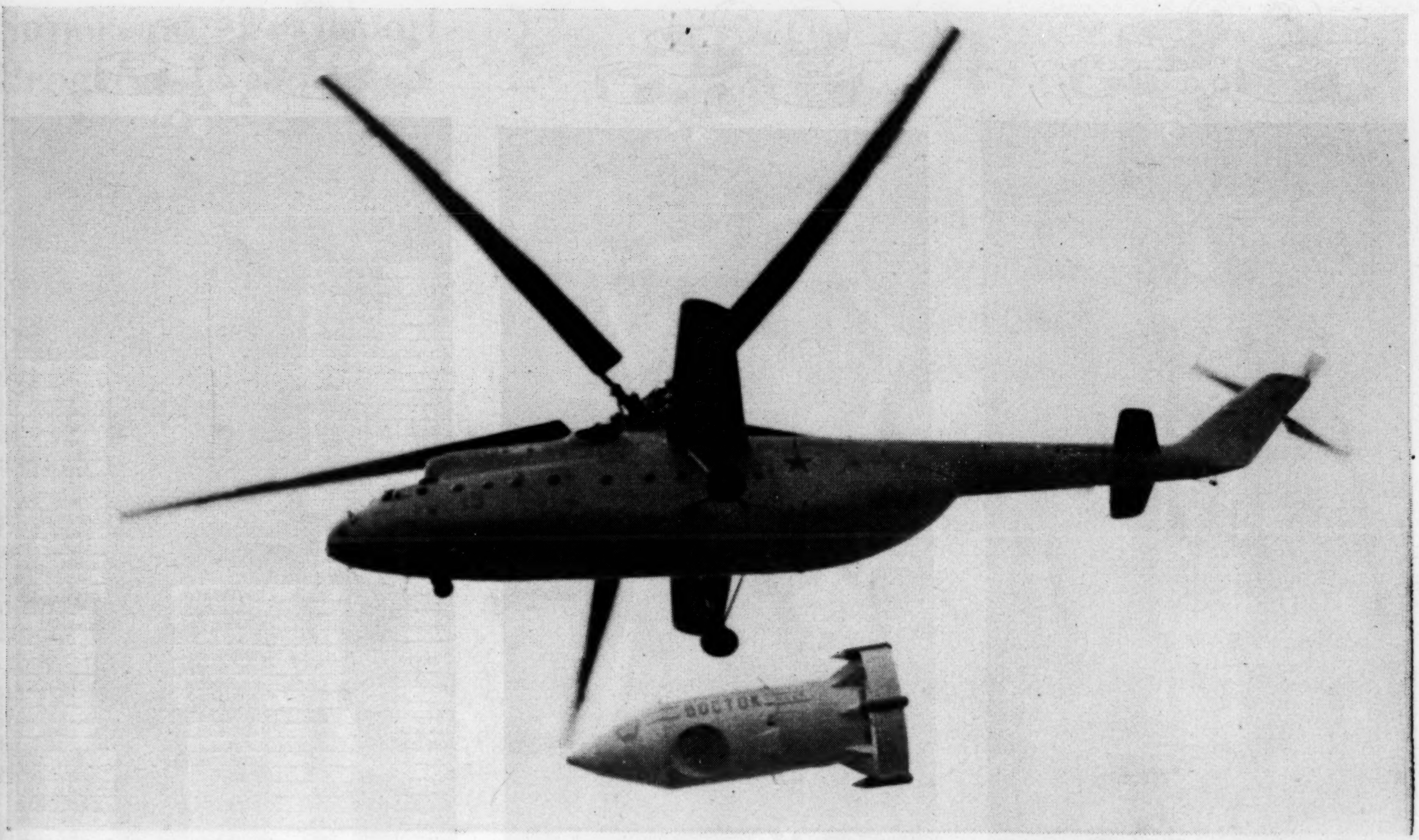
Fighters equipped with Bendix-Pacific radar beacons can rendezvous with jet tankers for refueling—in any weather with pin-point accuracy. These beacons are used in conjunction with equipment already installed in the jet tankers.

Bendix-Pacific beacons, a packaging modification of those operational in the B-58 bomber, provide identification, range and azimuth information for positive rendezvous.

Bendix-Pacific engineers are always available to discuss your specific problems.

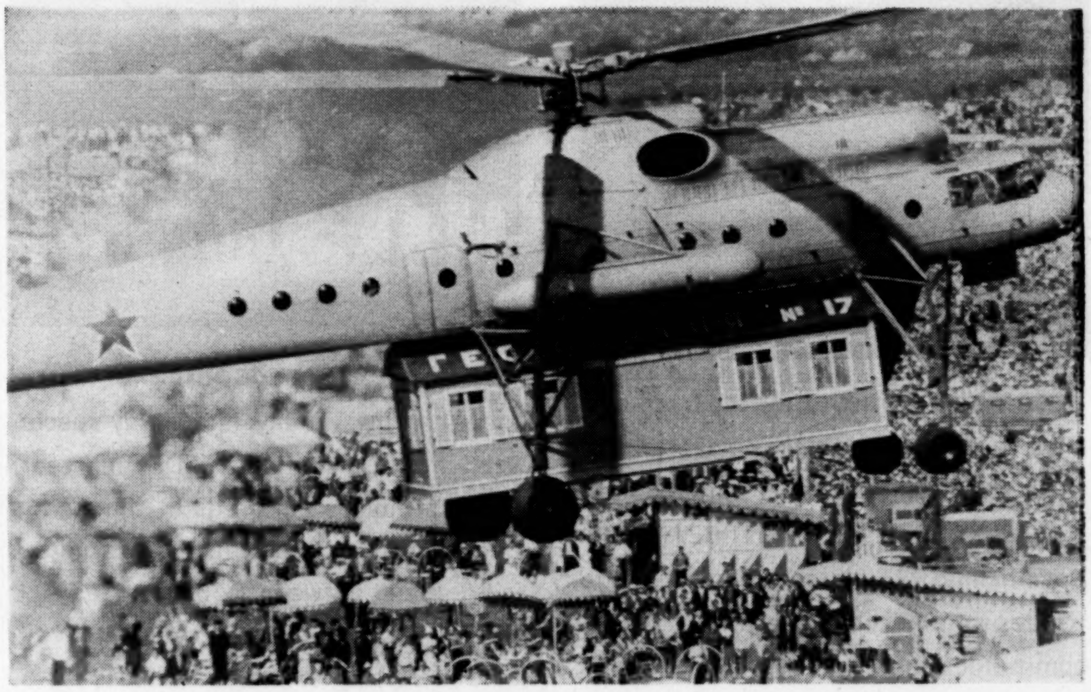
Bendix-Pacific Division
NORTH HOLLYWOOD, CALIFORNIA

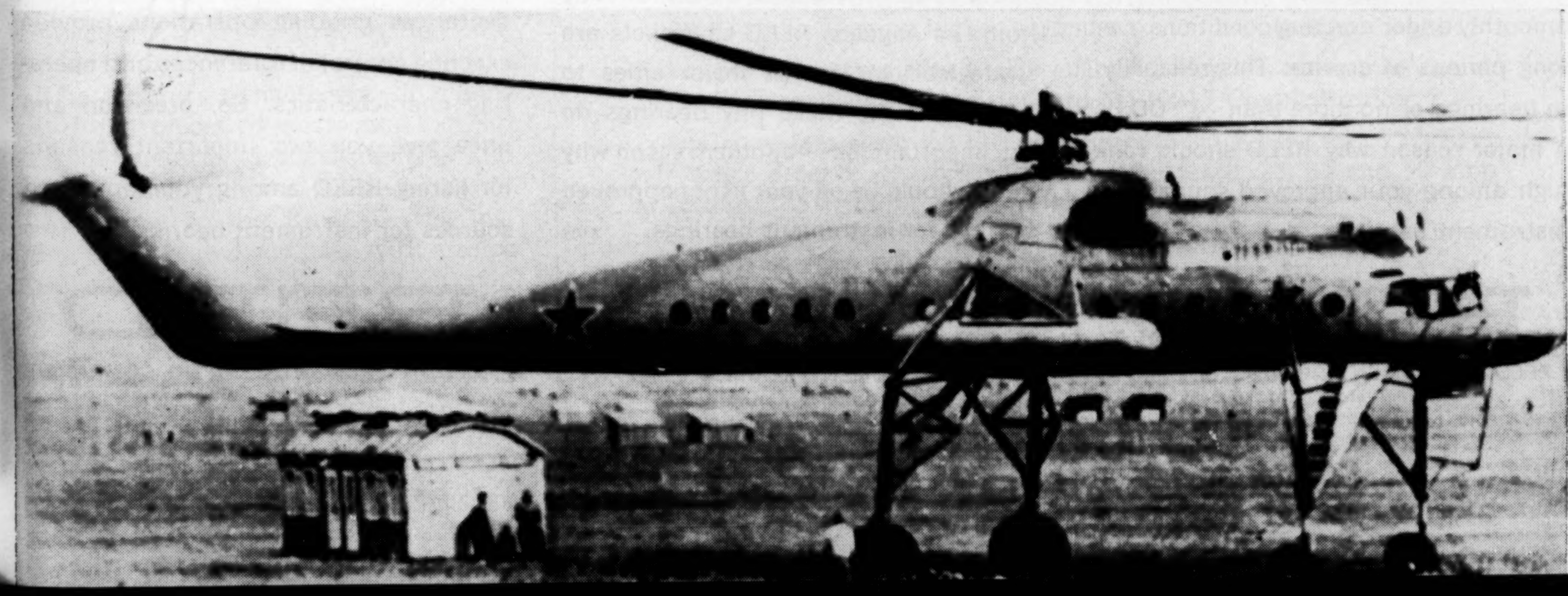
THE Bendix CORPORATION

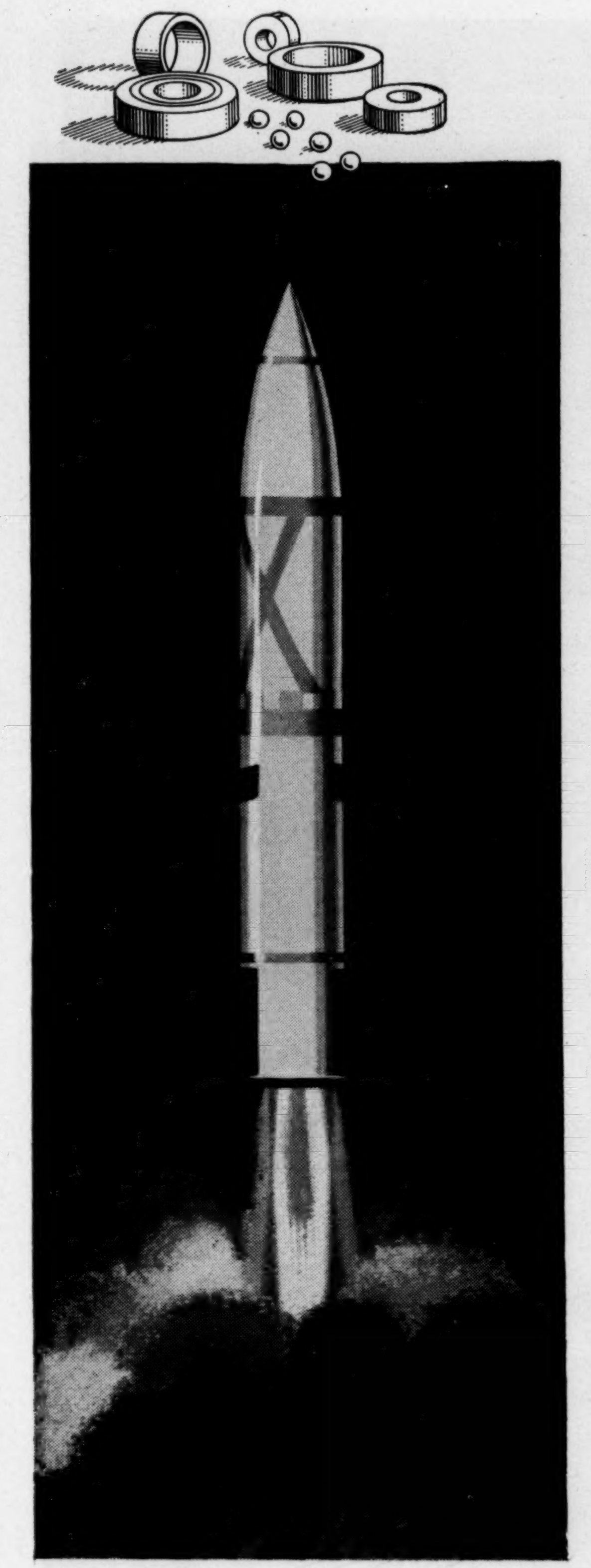


More Design Details Shown of Mi-6, Crane at Tushino

View from below of the Russian Mi-6 turbine helicopter, carrying what the Russians said was the Vostok space capsule, shows stub wings which partially unload the rotor during forward flight. Aft section of the capsule is of smaller diameter than the forward section. Retrorockets are contained in annular housing at the stern (AW July 17, p. 30). Flying crane (right and below), derived from the Mi-6, appears to have a longer fuselage and a larger rotor system. Projection on the belly at the nose is probably a telescoping compartment for a cargo handler crew member. Fuel tanks are mounted externally on the fuselage in line with the main rotor. Fuselage shows considerable modification from the Mi-6 and has 12 instead of 10 circular cabin windows. Landing gear of the crane appeared makeshift to Western observers.







Space-age achievements, from missiles to computers, owe a major part of their success to tiny but tremendously reliable REED INSTRUMENT BEARINGS. Specifically, REED bearings contribute to the dependability of miniaturized control, communications and navigation systems—through their ability to perform smoothly under exacting conditions over long periods of service. This reliability, in bearings of no more than ⅝" OD, is a major reason why REED should rank high among your approved sources for instrument bearings. 6108

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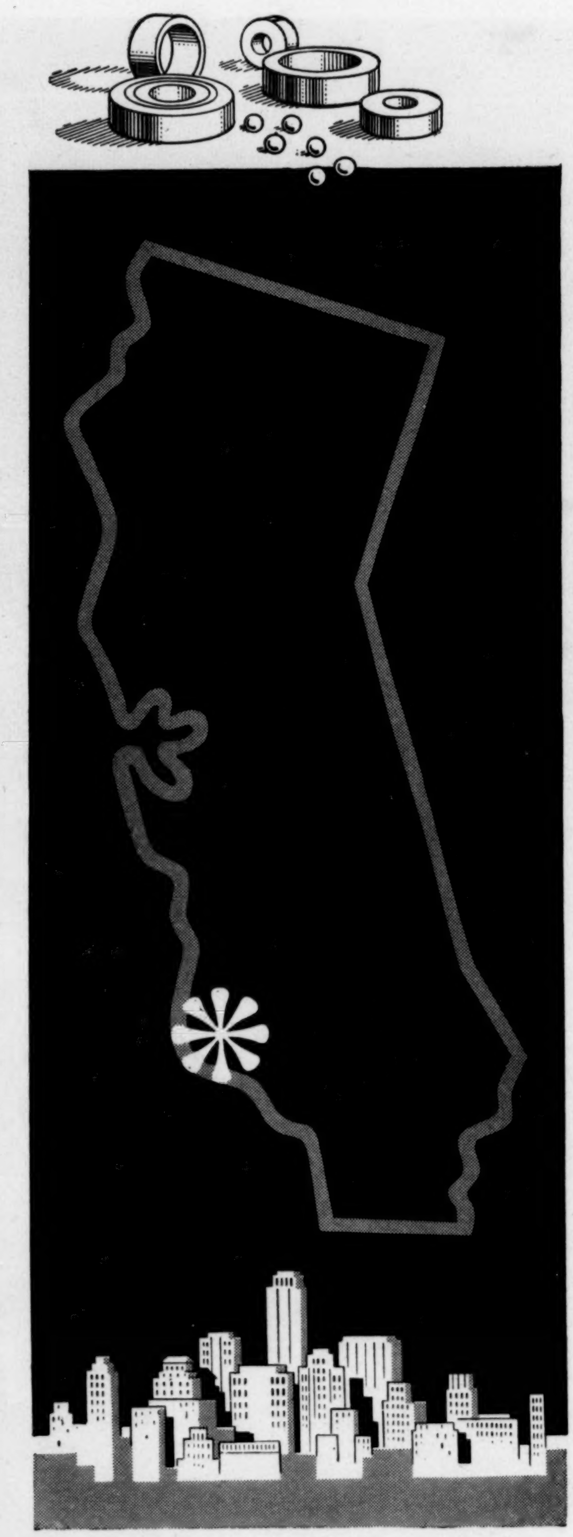

The big west coast source for instrument bearings, today, is a highly specialized producer named REED. Each year, REED produces hundreds of thousands of miniature and instrument bearings—in bore sizes between .0469" and .2500". REED also makes these bearings available nationally—through local stocks at REED sales offices and by air directly from Los Angeles. REED specialists are strategically-located in major cities to help you make these tiny bearings do big, important jobs—another reason why REED should be on your list of approved sources for instrument bearings. 6109

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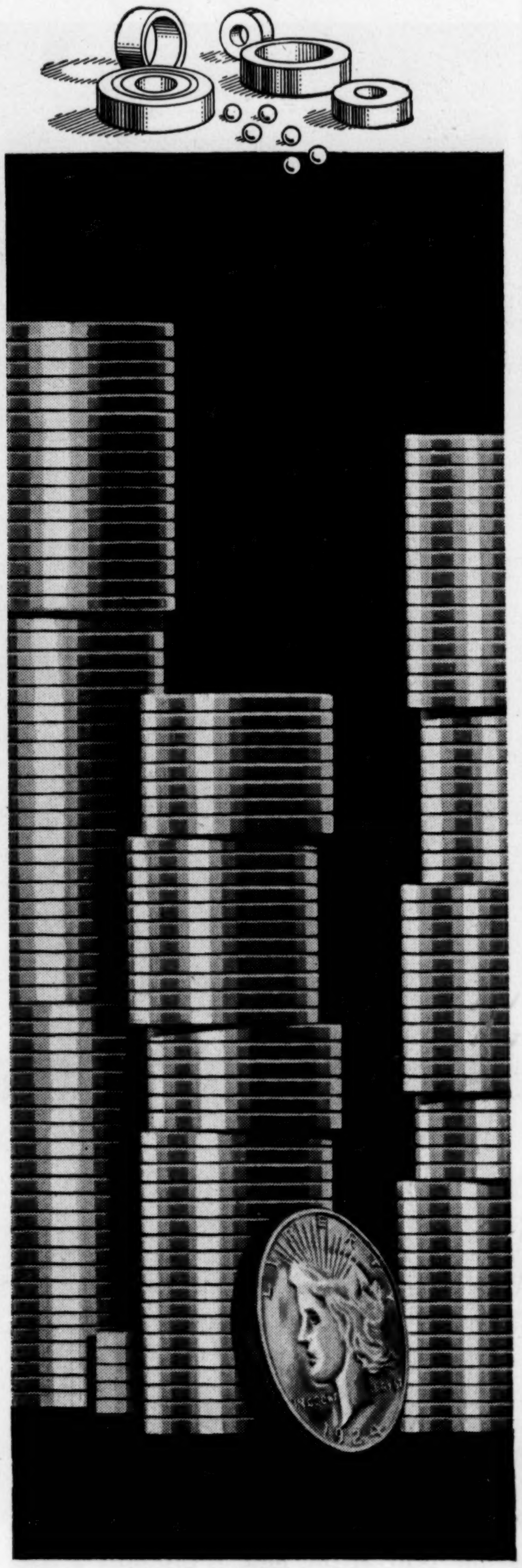

Today's big values in instrument bearings are the tiny but extremely precise bearings made by REED. Produced to ABEC-7 tolerances, they are available at no increase in price over ABEC-5. This added value, in bearings up to ⅝" OD, is possible because REED's centerless grinding operations provide exacting control of tolerances and operating characteristics. So, precision and price give you two important reasons for listing REED among your approved sources for instrument bearings. 6110

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Supersonic Transport Progress Is Reported

Washington — Federal Aviation Agency, Department of Defense and National Aeronautics and Space Administration recently concluded in a joint review of U.S. supersonic transport progress that sonic boom intensity "may be marginal" for both transonic acceleration and high-altitude cruise.

"Every resource should be brought to bear on the sonic boom problem," the report said. It also disclosed that at least one manufacturer submitting technical data to FAA believes that the supersonic transport may be restricted to flight over unpopulated geographical areas.

Estimated costs for airframe development forwarded to FAA by industry ranged from $75 million, which includes the construction of two experimental prototype aircraft, to $348 million, which includes construction of two prototypes plus one "preproduction" aircraft.

Engine development costs ranged from $200 million to $350 million, depending on the approach taken by the manufacturer.

Most manufacturers agreed that the Western airline market for supersonic transports in the 1968-1975 period entails production of 100 to 200 aircraft. However, one estimate went as high as 450 aircraft and one as low as 75. On production aircraft cost, estimates varied from $12.6 million to $20 million per unit.

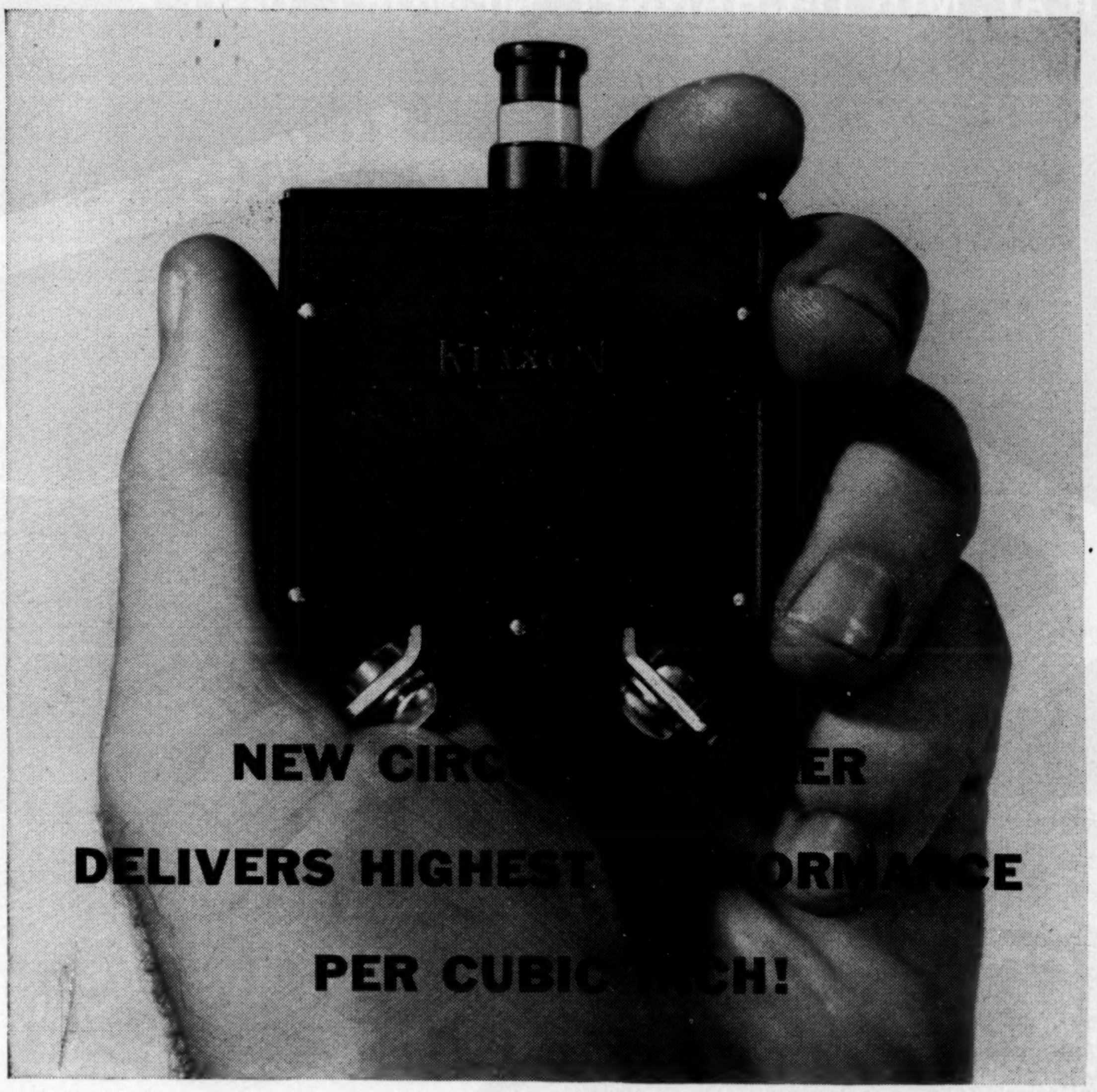
Old Tu-104 Engines Used in Mining Work

Moscow—Jet engines from Russian Tu-104 transports are being tried out as high-speed earth movers at Soviet open-pit mines after they have accumulated the maximum flying service life allowed by Aeroflot.

Engineers A. P. Degtyarev and S. M. Vinogradov have developed a method of anchoring a used jet engine to a fixed metal platform and attaching a steel pipe 23 ft. long and 1.64 ft. in diameter at the barrel. Earth and rock removed by an excavator are fed into the barrel from a bunker above.

The engine's exhaust stream reportedly hurls pieces of earth and rock up to eight inches in size a distance of 200 meters (656 ft.) "in an endless volley."

According to the Russians, the machine "can easily keep pace with a rotor excavator. Along side of a belt conveyor, the unit looks like a toy. It weighs 100 times less and costs about half as much. Most importantly, its manufacture does not require any new production capacity."



It's the KLIXON® 6752-12

designed, produced and flight-approved

for the Boeing B-52H

The new KLIXON 6752-12 . . . approved in all ratings . . . is in a class by itself. It's so much better than previous aircraft circuit breakers that new Mil Specs are being written to cover its higher performance standards. Its superiority comes from a unique combination of advantages.

High rupture capacity: 6,000 amp 120 V-ac 400 cps; 4,200 amp 205 V-ac 400 cps; 6,000 amp 30 V-dc.

Ambient temperature compensation maintains protective capabilities from −65°F to +250°F.

Coordinated ratings remove low current circuits from line in case of fault, while keeping higher current circuits in operation.

Longer operating life: 20,000 guaranteed cycles, more than double the life expectancy of the standard MS25017 Circuit Breaker.

For complete data on the reliability-proved KLIXON 6752-12 Circuit Breaker . . . in 2½, 5, 7½, 10, 15, 20, 25, 35 and 50 amp ratings . . . write for literature today.

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A CORPORATE DIVISION OF
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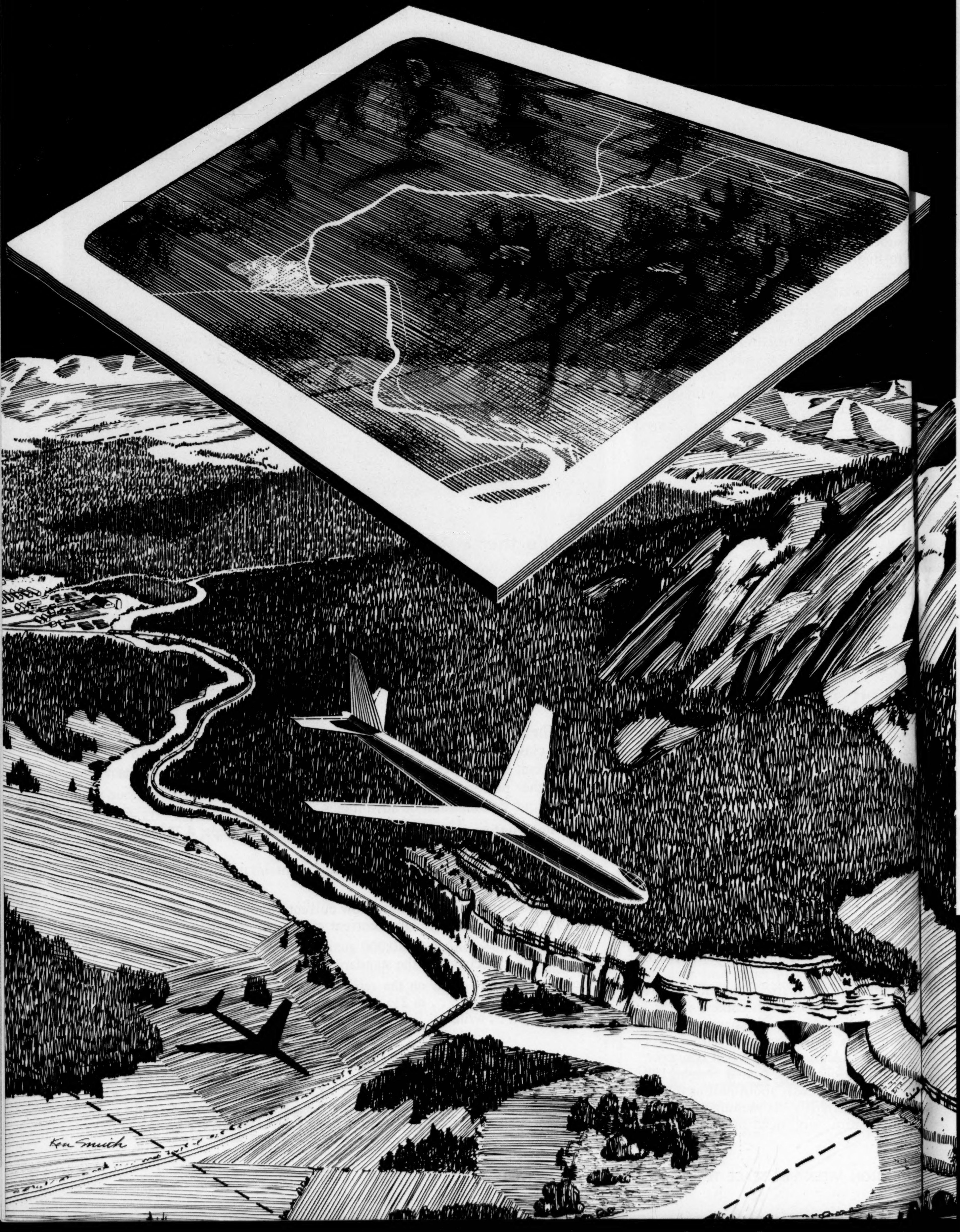
TYPICAL MULTI-CHANNEL MEMORY UNIT *



MARQUARDT MULTI-CHANNEL MEMORY SYSTEM

allows realistic simulation of longer range and lower altitude tactical training missions

Based on a major technical breakthrough in information storage, Marquardt's new bombardier/navigator radar trainer system provides outstanding simulation characteristics. The flexibility and capacity of the Multi-Channel Memory—a high density storage medium—make possible realistic simulation systems capable of meeting the advancing speed, range, and altitude requirements of aero-space technology.

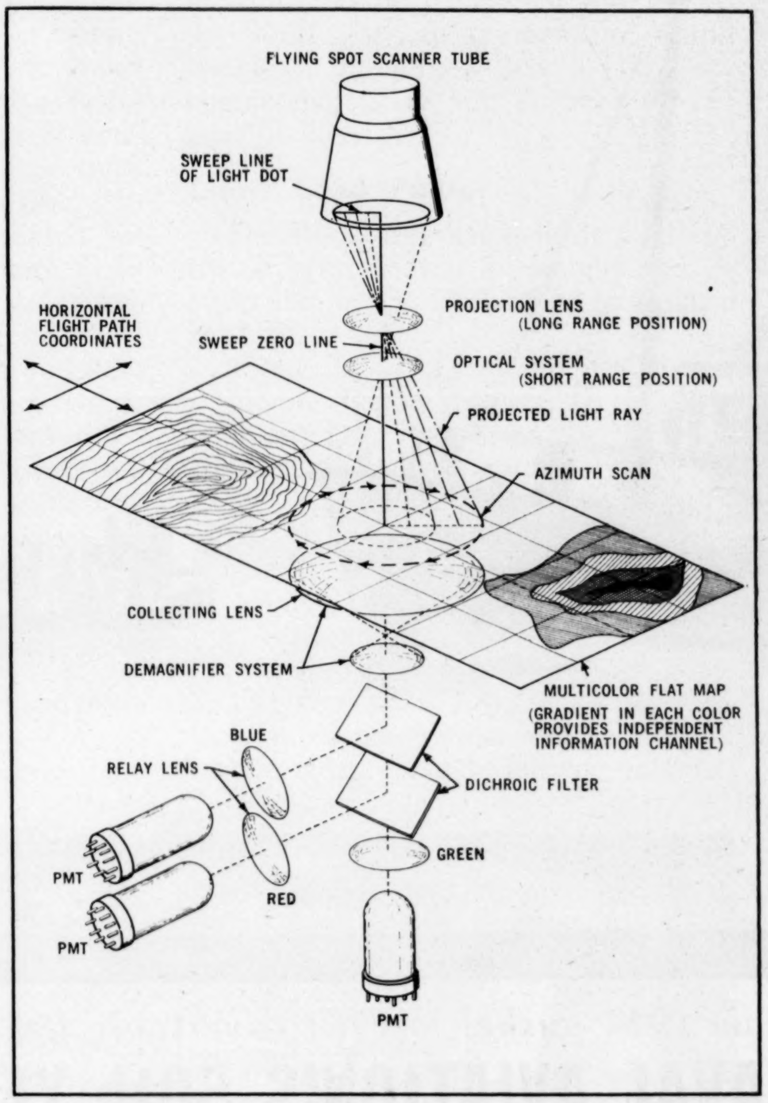
The Multi-Channel Memory uses a three color film transparency in which terrain information and radar reflectivity data are stored on a map scale ratio of three million to one, or better. A highly detailed terrain map representing a land mass area 2,000 miles by 3,000 miles can be permanently stored on a slide only 48 inches by 72 inches. Because the map transparency is flat and terrain elevations are reproduced electro-optically, there are no physical limitations to its use. The system is particularly well suited for very low altitude simulation.

Information in the Multi-Channel Memory System is coded as varying densities of the three colors of the film transparency. During operation the transparent map is scanned by a flying spot scanner. After passing through the film the light is separated into various channels by filters and mirrors and converted to electronic signals by photomultiplier tubes. The light intensity in each channel is dependent upon the absorption of the corresponding color dye in the film. The signals are then processed by a high speed computer and displayed on the face of the PPI (plan-position-indicator) radar display.

Because of its flexibility and large storage capacity, the Multi-Channel Memory System has application to missile and space training problems, information storage and retrieval, automatic language translation, advanced command and control systems, and similar computer uses.

The bombardier/navigator training system mentioned above, and now being developed for the Air Force, is the result of more than ten years of experience in the development and manufacture of trainers and simulators. Marquardt has successfully produced, installed and maintained world-wide—on time and at low cost—bombing and navigation trainers, gunnery radar trainers, AEW/CIC trainers, special purpose trainers, and ground control intercept trainers. For information concerning Marquardt's training and simulation systems capabilities, contact William Lord, Pomona Division, The Marquardt Corporation, Pomona, California.

Scientists and engineers experienced in the fields of simulation and training systems are invited to investigate exceptional career opportunities with The Marquardt Corporation. All qualified applicants will receive consideration regardless of race, creed, color, or national origin.


FLYING SPOT SCANNER TUBE
SWEEP LINE OF LIGHT DOT
HORIZONTAL FLIGHT PATH COORDINATES
SWEEP ZERO LINE
PROJECTION LENS (LONG RANGE POSITION)
OPTICAL SYSTEM (SHORT RANGE POSITION)
PROJECTED LIGHT RAY
AZIMUTH SCAN
COLLECTING LENS
DEMAGNIFIER SYSTEM
MULTICOLOR FLAT MAP (GRADIENT IN EACH COLOR PROVIDES INDEPENDENT INFORMATION CHANNEL)
BLUE
RELAY LENS
DICHROIC FILTER
GREEN
PMT
RED
PMT
PMT

DATA EXTRACTION FROM COLOR TRANSPARENCY

The principle of land mass simulation storage and readout is shown above. Terrain elevation and radar reflectivity are coded as varying densities of the three colors of a color film transparency. As the light source simulates airborne radar scan, signals are generated by the photomultipliers to provide information necessary to simulate a radar presentation.

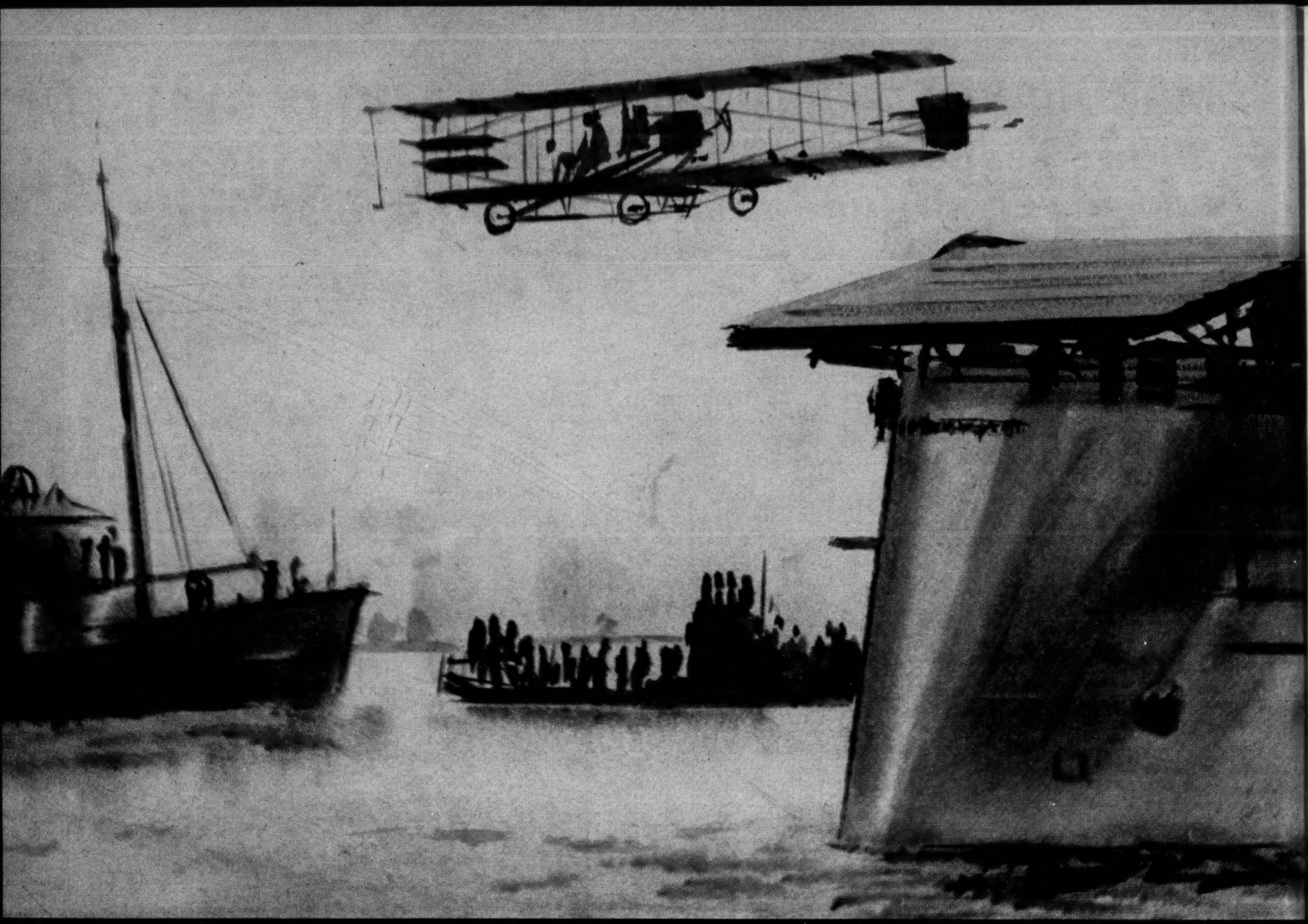
★ MULTI-CHANNEL MEMORY UNIT

Shown on the opposite page is the heart of the Multi-Channel Memory System — a three color film transparency. Each color provides a permanent and separate information channel in perfect register at any point no matter how large the map.

THE *Marquardt* CORPORATION

CORPORATE OFFICES, VAN NUYS, CALIFORNIA

ASTRO ◆ OGDEN DIVISION
◆ POMONA DIVISION
◆ POWER SYSTEMS DIVISION



From 1911 pusher to 1961 supersonic jets...

NAVAL AVIATION'S 50th YEAR OF OPERATIONAL READINESS

Naval Aviation was launched fifty years ago with the first round-trip flight from a naval vessel. The time was January 18, 1911. The place was San Francisco Bay. Eugene Ely took off and landed a Curtiss biplane from a wooden platform especially constructed on the cruiser U.S.S. Pennsylvania. His top speed was 50 knots. Today, powerful jet fighters, such as the McDonnell F4H "Phantom II" are routinely catapulted by steam catapults from quarter-mile long carriers. Capable of flying at twice the speed of sound, these new jet aircraft can strike swiftly in the cause of freedom, from the 70% of the earth's surface covered by navigable water.

Del Mar salutes the officers and men of Naval Aviation who, down through the years, have steadfastly maintained their operational readiness to face any world crisis.

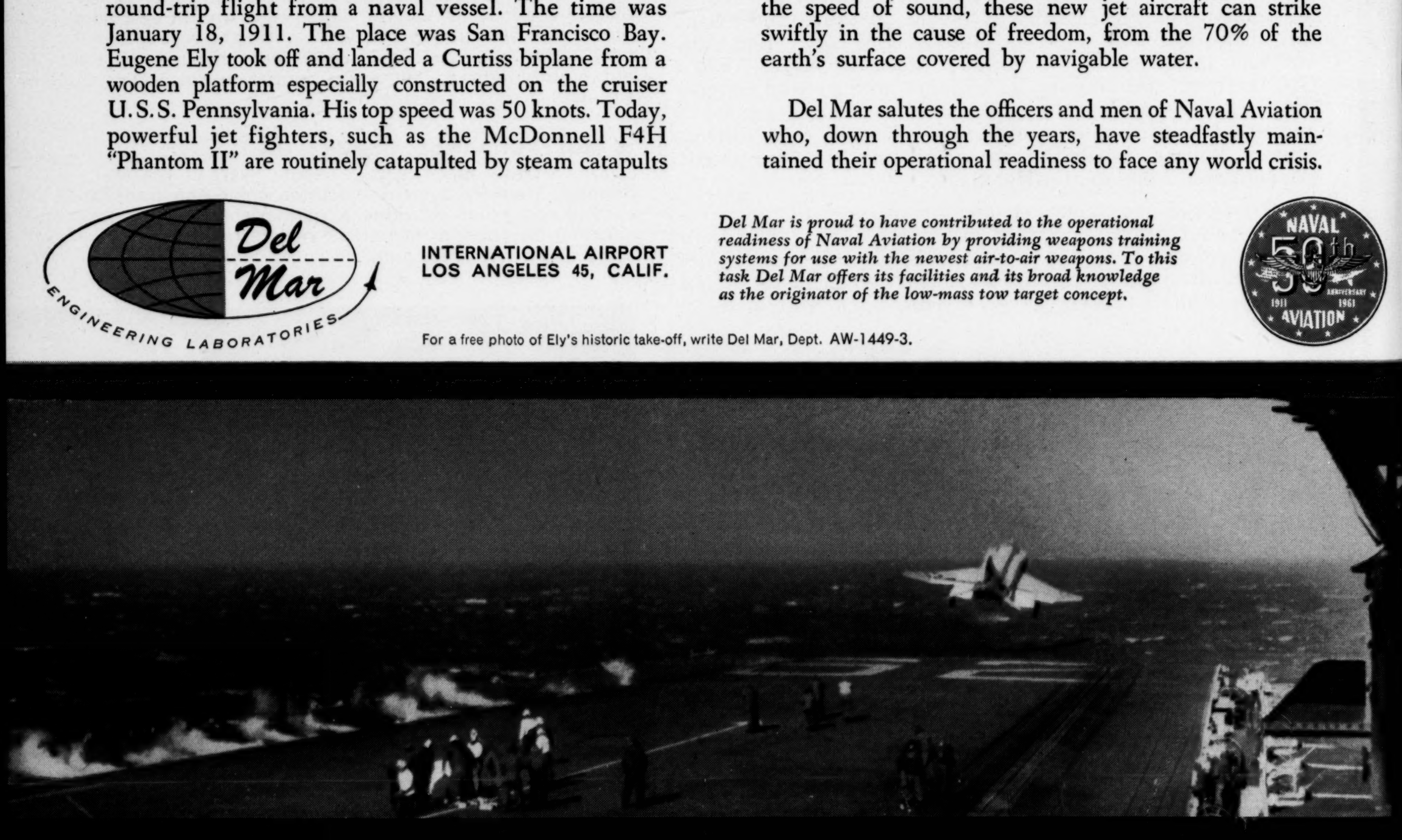
Del Mar
ENGINEERING LABORATORIES

INTERNATIONAL AIRPORT
LOS ANGELES 45, CALIF.

Del Mar is proud to have contributed to the operational readiness of Naval Aviation by providing weapons training systems for use with the newest air-to-air weapons. To this task Del Mar offers its facilities and its broad knowledge as the originator of the low-mass tow target concept.

NAVAL 50th ANNIVERSARY 1911 1961 AVIATION

For a free photo of Ely's historic take-off, write Del Mar, Dept. AW-1449-3.



Speys to Boost NA.39 Attack Capability

Blackburn NA.39 Buccaneer low-level strike aircraft for the Royal Navy, now under development in a Mk. 2 version with higher powered turbine engines, is a two-place airplane housing a bomb bay capable of carrying the largest planned weapon stores.

Design team now is working on installation of Rolls-Royce RB. 163 Spey turbojet engines of 10,100 lb. thrust each, to replace the de Havilland Gyron Junior turbines of 7,000 lb. thrust now powering the Mk. 1 Buccaneer (AW May 29, p. 29). New powerplants should give the NA.39 a Mach 1.2 capability on the deck. Plane now cruises at Mach .85 with a maximum speed of Mach .95.

Current production aircraft has a wing area of 500 sq. ft., a span of 42.5 ft. and an aspect ratio of 3.58. Wing sweepback is graded along the leading edge; zero to 55% span is swept at 40 deg. and the 55-100% span is swept at 30 deg. Root chord is 17 ft. $9\frac{1}{2}$ in. and the mean aerodynamic chord is 11 ft. 9 in.

Takeoff Weight

Utilizing the present Gyron Junior engines, the design takeoff weight is 38,500 lb. and minimum launch speed is 110 kt. Internal fuel capacity is 2,024 gal. but maximum takeoff weight can be up to 46,000 lb. carrying 3,984 gal. The wing has no internal provision for fuel but two 400-gal. drop tanks can be carried on the wing externally. The bomb bay can hold a 1,000-gal. tank. At maximum weight, the minimum launch speed is 124 kt.

The cockpit is fitted with tandem seats, both of the Martin-Baker ejection type, and the rear seat is offset and raised 12 in. above the front seat. Rear seat also tilts forward to keep physical contact between two crewmen. Speed brakes split open at the tail of the NA.39 and with brakes open and radome nose folded back, the fuselage length of 61 ft. 6 in. is decreased about 10 ft. for better storage aboard carriers (AW Jan. 9, p. 63). Total width with the wings folded is 20 ft.

Primary weapon is a bomb that could weigh up to 4,000 lb. It is carried in a rotary bomb bay 17 ft. 6 in. long and 3 ft. 4 in. wide that could be modified to handle a special weapon or a gun pod. Because provisions can be made for a hose and drogue in the bomb bay, the NA.39 could be used as a tanker; dry tank range carrying full fuel would be 3,350 naut. mi.

The bomb bay also allows a high degree of accessibility to flight controls and the hydraulic system. Bay door is unique in that as it opens, the bomb partly emerges from the airplane.

Internal fuel system includes six bags of the non-self-sealing type in the fuselage. Each bag contains a pump and about 250 gal. of fuel. The system includes accumulators to allow about 15 sec. of inverted flight and a Rotol proportioner is used for center of gravity control. A manual cross feed splits the system for use by each engine.

Hydraulic system, maintained at 4,000 psi., operates the primary flight controls, landing gear and flaps, bomb doors, speed brakes and landing hook, nose wheel steering and wing and nose folding mechanisms. Air conditioning unit operates at 4 psi. maximum differential and includes an electric windshield with air defogging devices. Windshield is of $\frac{15}{16}$th in. laminated glass.

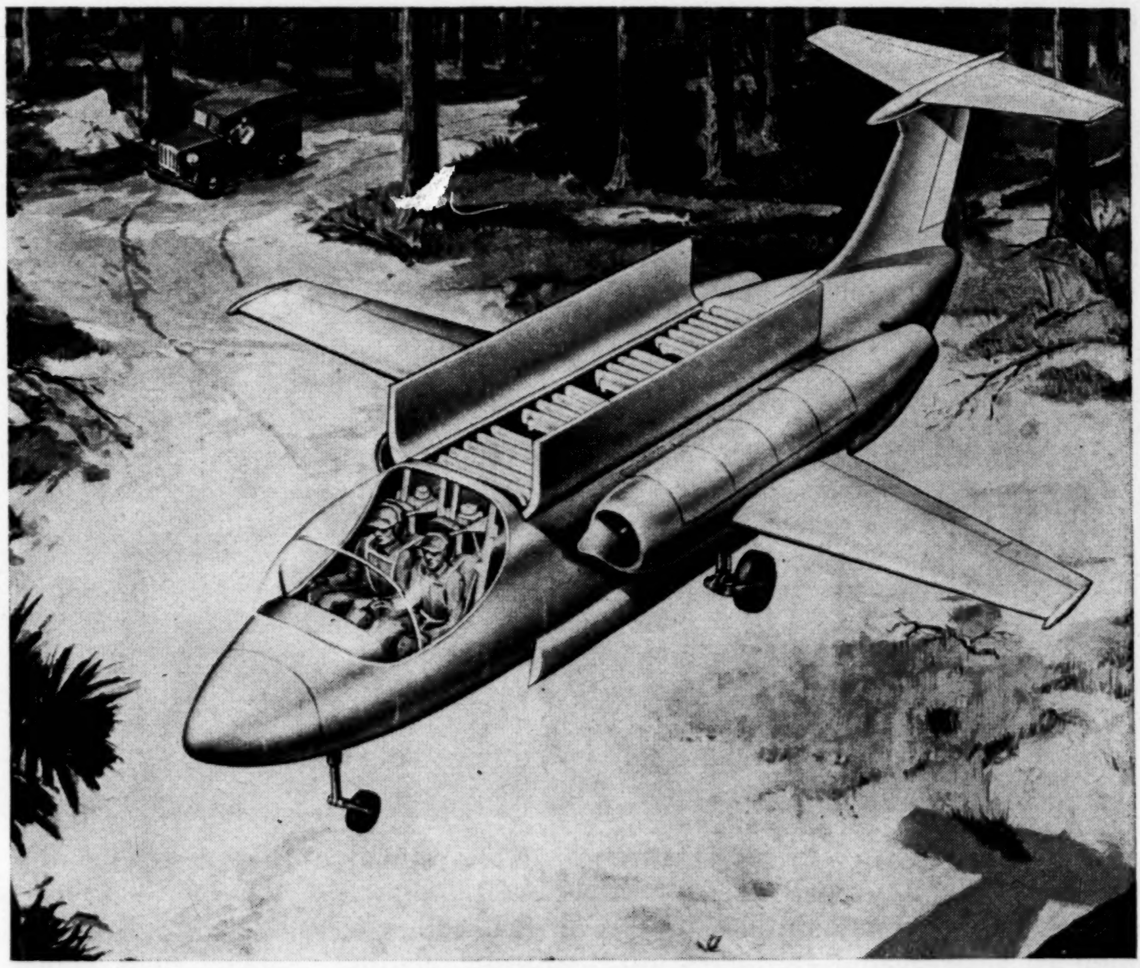
Hot air anti-icing system has a duration of 30 min. for wing, tail and duct inlets and operates at an outside air temperature range of −10C at sea level to −20C at 30,000 ft. Heat transfer efficiency is about 50%. For example, at 200 kt. sea level, hot air temperature would be 125C, bleed mass flow would be 6 lb./sec., engine mass flow would be 90 lb./sec and per cent of bleed would be 6.7%. At 470 kt. at 30,000 ft., hot air temperature would be 135C, bleed mass flow 8.5 lb./sec., engine mass flow 100 lb./sec and per cent of bleed 8.5%.

Limit Load Factor

The Buccaneer has a limit load factor of 8g at 34,480 lb. weight and 7g at 38,500 lb. Design landing sink speed is 19 fps.

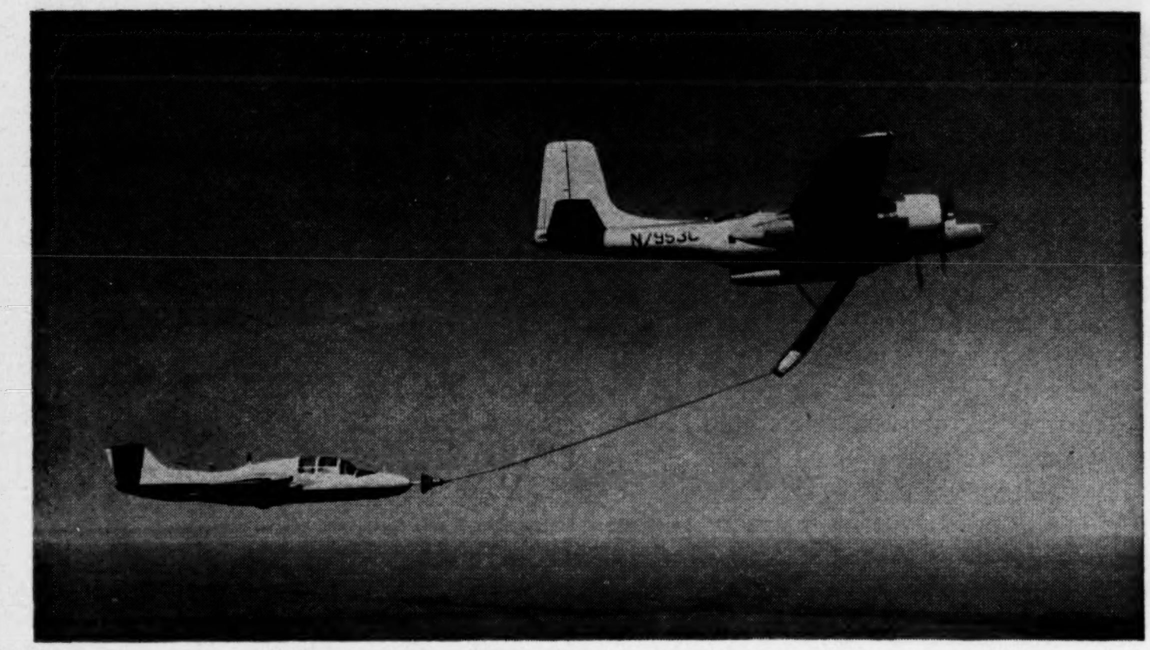
About 12% of the engine airflow from the Gyron Juniors is used for boundary layer control on the flaps and ailerons, reducing approach speed by 15 kt. Either engine provides sufficient air for landing in case of emergency. Engine thrust is reduced about 18% by using the 12% mass flow for blowing. Spey engines also have provisions for blowing air over control surfaces.

The airplane is equipped with a 12-in. scanner range radar and an ASU-21 search radar. Search radome is made



Lockheed Hummingbird in R&D Status

Lockheed Hummingbird design uses a system of ejector-mixing chambers located in the fuselage of the aircraft which is fed by high-velocity exhaust diverted from the two jet engines mounted in pods along either side of the fuselage. For vertical takeoff, the flush doors, enclosing the mixing chamber, are opened and gases are diverted from the engine and fed to the mixing chamber. The gases then are directed downward through jet nozzles for vertical lift. Plane, in R&D status for the Army Transportation Research Command, Ft. Eustis, Va., would be powered by two P&W JT12s generating 3,000 lb. of thrust each, would have a wingspan of 25 ft. 8 in., and an over-all length of 32 ft. Lockheed test pilots have flown a tethered flight rig to prove feasibility of the ejector augmentation principle.



Navy Studies Beech Air Refuel System

Beech-designed air refueling system, housed in a 16-ft. aluminum pod, has passed initial evaluation at the Navy's Patuxent River, Md. test center. Nearly 50 successful connections have been made by Grumman F9F, McDonnell F4H, Douglas A4D, North American A3J and Chance Vought F8U aircraft. System is shown being air-tested over Wichita, Kan., using a Morane-Saulnier MS-760 twin-jet light plane as the receiver and a surplus B-26 as the tanker. Electrical release of the funnel-shaped drogue pulls out a 40-ft. length of hose, in turn forcing out the boom.

of sandwich construction. Avionics gear includes an electronic countermeasures device in the bomb bay, a lightweight doppler navigation radar and a radio altimeter. Two 28 v.d.c inverters are installed. Mk. 1 version of the Buccaneer does not have a terrain clearance warning device. Total weight of radio and radar gear, including usual UHF and HF units, is 1,190 lb.

The Buccaneer's autopilot includes autostabilization which is available at all times on three axes. It provides a climb attitude with a Mach number lock and has special provisions for cruising at low altitude, in addition to programed maneuvers for bombing. The airplane, using this device, can be flown by electronic signals generated by the pilot and then injected to the power controls, thus reducing pilot fatigue.

A typical low-level mission, carrying a 4,000-lb. bomb, would call for takeoff using 430 lb. and climb to 20,000 ft., using another 610 lb. of fuel. From here, the NA.39 would descend to 15,000 ft. and then to sea level, cruising at sea level at speeds up to 560 kt. Five minutes of combat would be spent at sea level and the NA.39 then would climb back to 30,000 ft. for return. Mission profile calls for a 20-min. loiter at 10,000 ft. with one engine out.

Total fuel requirements for the mission would be 430 lb. for takeoff, 1,000 lb. for climbing, 9,920 lb. for total cruise and 790 lb. for the loiter.

The Buccaneer has a high rate of climb; for instance, at a gross weight of 27,000 lb., the airplane will climb at 14,000 fpm. at sea level; 7,200 fpm. at 20,000 ft. and 1,500 fpm. at 40,000 ft. Absolute ceiling appears to be about 47,000 ft. At a higher gross of, say, 45,000 lb., rate of climb at sea level drops to 7,700 fpm. and at 20,000 ft. to 3,200 fpm.

Normally the pilot would cruise from his base, or carrier, to 250 naut. mi. from target, then descend to sea level at a speed of at least 400 kt. true airspeed and maintain that speed until he is 100 naut. mi. from the target. The final 100 mi. would be flown at speeds ranging from 525 to 560 kt. After five minutes at the target area, the NA.39 would fly back 100 naut. mi. on the deck before returning to cruise altitude.

Maximum dive speed is 660 kt. indicated airspeed.

Fatigue life of the airplane is estimated at 1,000 hr. of cruising at low level, or 1,000 deck landings. However, this life can be extended indefinitely if the main component attachment bolt holes are opened outward to remove the fatigued material, and then bushed to bring them back to proper design sizes.

It is estimated that design of the NA.39 prototype took 15,000 man hours and construction of the first airplane another 280,000 man hours. For a batch of 50 airplanes, man hours required would be 137,500; for 100 airplanes, 97,200 and for 200 airplanes, 70,150.

Wing skins are built in one piece with no provisions made for carrying fuel inside. A single span bending connection is provided at the wing fold. Lift coefficients of the clean wing are .96 maximum; 1.24 with flaps at 45 deg. and ailerons at 30 deg., no blowing; 2.00 with flaps at 45 deg., ailerons at 30 deg. and 12% bleed blowing.

Fuselage incorporates the area rule concept for a reduction of possibly 50% in wave drag at Mach 1, 67% at Mach 1.05 and 50% at Mach 1.1. Parasite drag coefficient (C_{d_0}) is 0.017 at a Reynolds number of 6 x 10^6. Maximum rate of roll is 240 deg./sec. Total wetted area of the NA.39 is 2,065 sq. ft. and the maximum cross sectional area is 60 sq. ft.

The horizontal tail has an area of 75 sq. ft. and a span of 14 ft. 2 in. Blowing air is provided on the leading edge at the 5% chord. Tail arm is 24 ft.; surface motion is 20 deg. nose-up and 8 deg. nose-down. Aspect ratio is 2.7.

Vertical fin area is 67 sq. ft. with an aspect ratio of .73. The fin has a thickness of 7.5% and a 65-deg. sweep.

Total structure weight is 12,480 lb. and the Gyron Junior powerplants add another 3,984. Minimum flying weight is 22,690 lb. and total equipment weight is 2,176 lb. In a component breakdown, the wing weighs 5,650 lb.; fuselage (basic structure, bomb bay doors, speed brakes) weighs 4,150 lb.

PRODUCTION BRIEFING

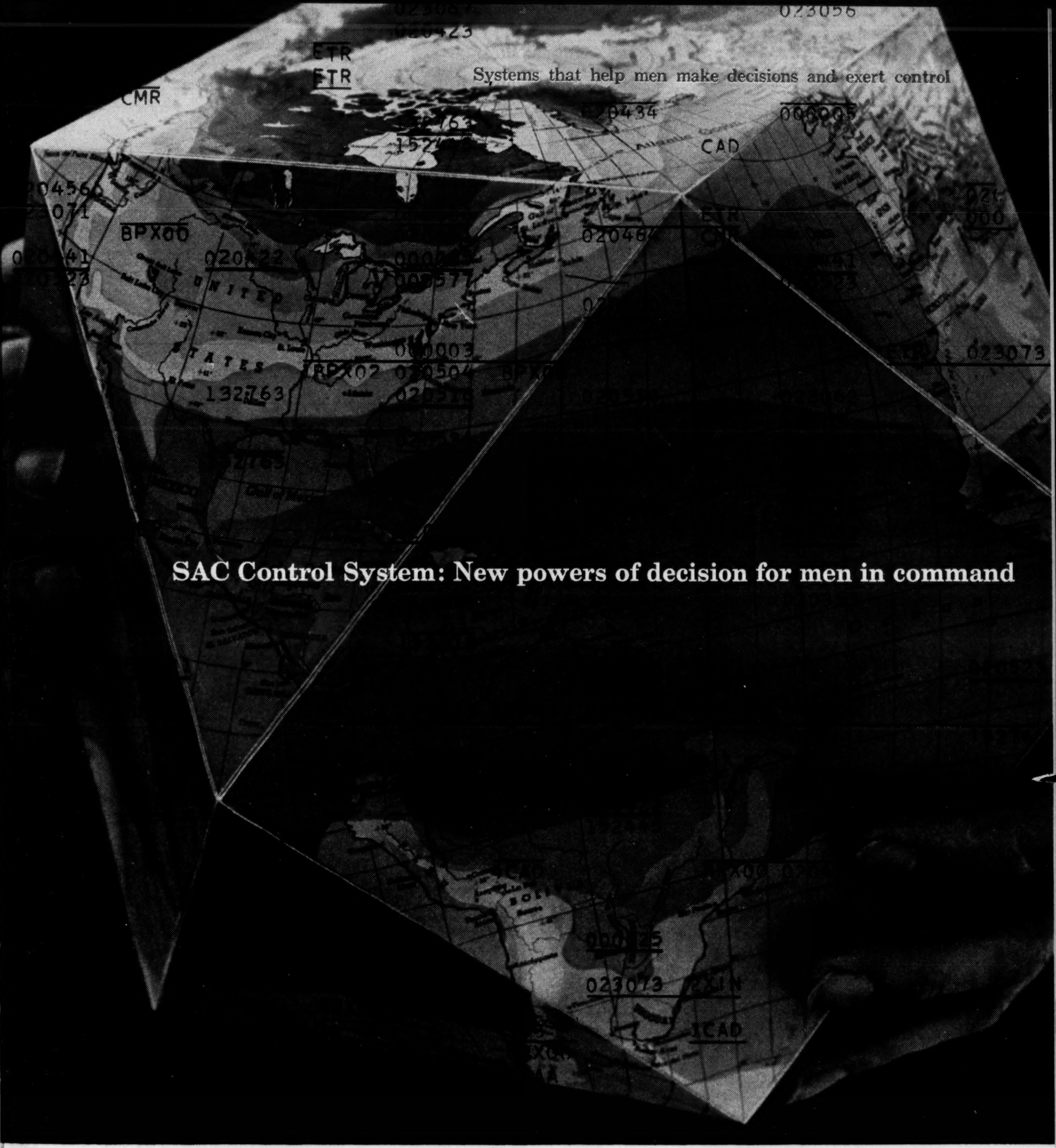
Grand Central Rocket Co. successfully test-fired a segmented solid-propellant rocket motor 3 ft. in diameter containing about 2½ tons of propellant which produced an average thrust exceeding 30,000 lb. Rocket, which was test-fired under an R&D program sponsored by Air Force Flight Test Center, Edwards AFB, consisted of a center segment and two end caps.

Minneapolis-Honeywell has a National Aeronautics and Space Administration contract for design and engineering services for a Goddard Space Flight Center space environment facility which will include two test chambers for large spacecraft.

Orenda Engines, Ltd. has received a contract through the Canadian Commercial Corp. for joint U. S. Army-Navy development of a 600-hp. turbine engine for marine and vehicle propulsion. Ford Motor Co. and Solar Aircraft have similar contracts.

Radio Corp. of America has a contract from Lockheed Missiles and Space Div. to build and install an automatic programmer and test system (Apats) in an environmental test chamber for satellites.

Hercules Powder Co. has an Air Force Ballistic Systems Division contract totaling over $50 million and calling for continued research and development on the Minuteman third stage engine and for delivery of flight test units.



Systems that help men make decisions and exert control
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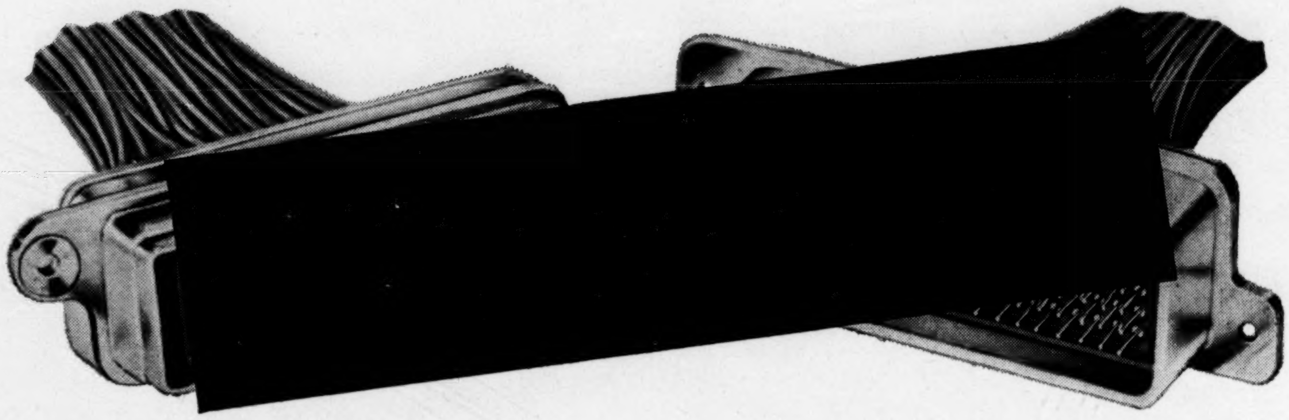

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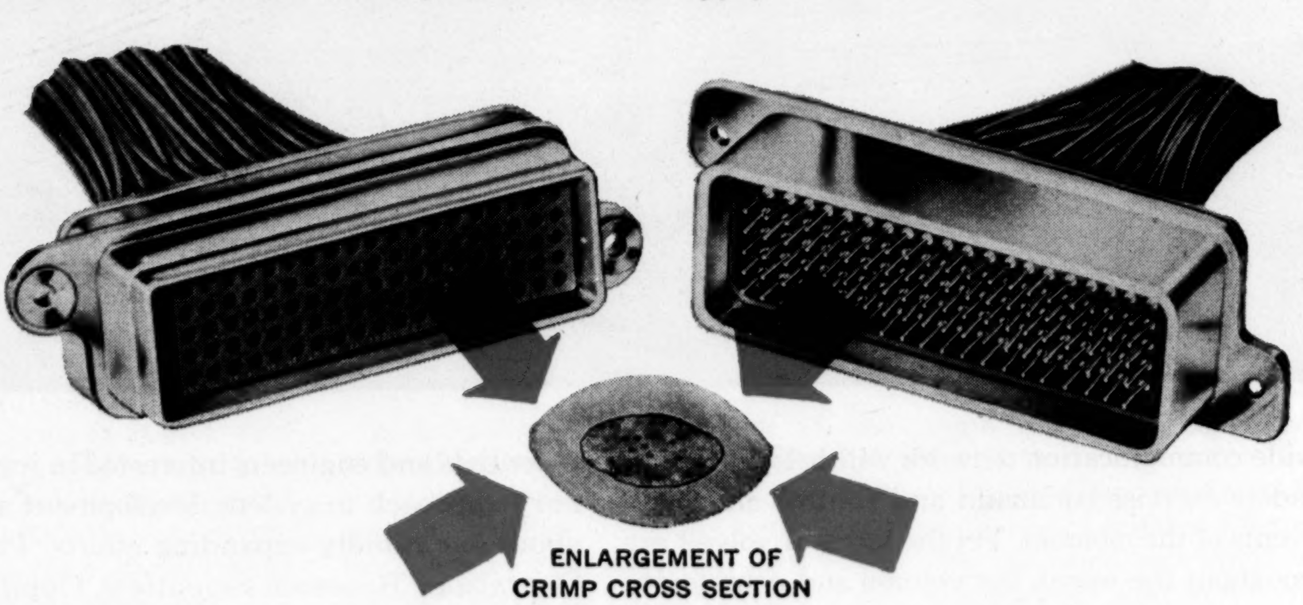

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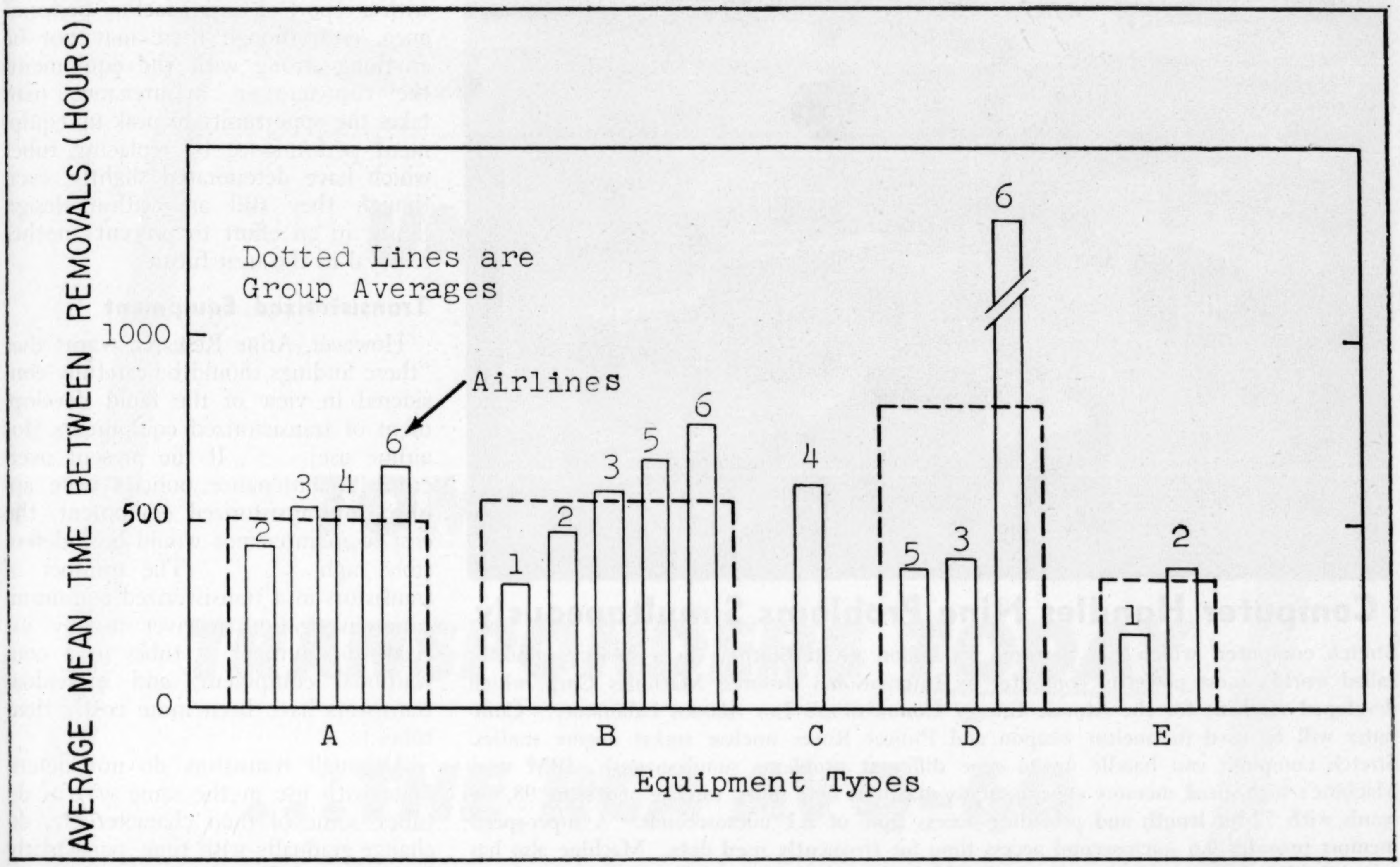


THREE-YEAR airline avionics reliability evaluation, using three types of navigation receivers and two types of communications receivers operated by six airlines, reveals greater variation in reliability among individual airlines than between different types of equipment because of individual operational and maintenance policies. Program revealed that communications sets had fewer catastrophic failures than navigation equipment, but were removed much more frequently because performance is more difficult for pilot to evaluate in flight. Study, conducted by Arinc Research Corp., points up potential problems for transistorized equipment.

Arinc Surveys Airline Avionics Reliability

By Philip J. Klass

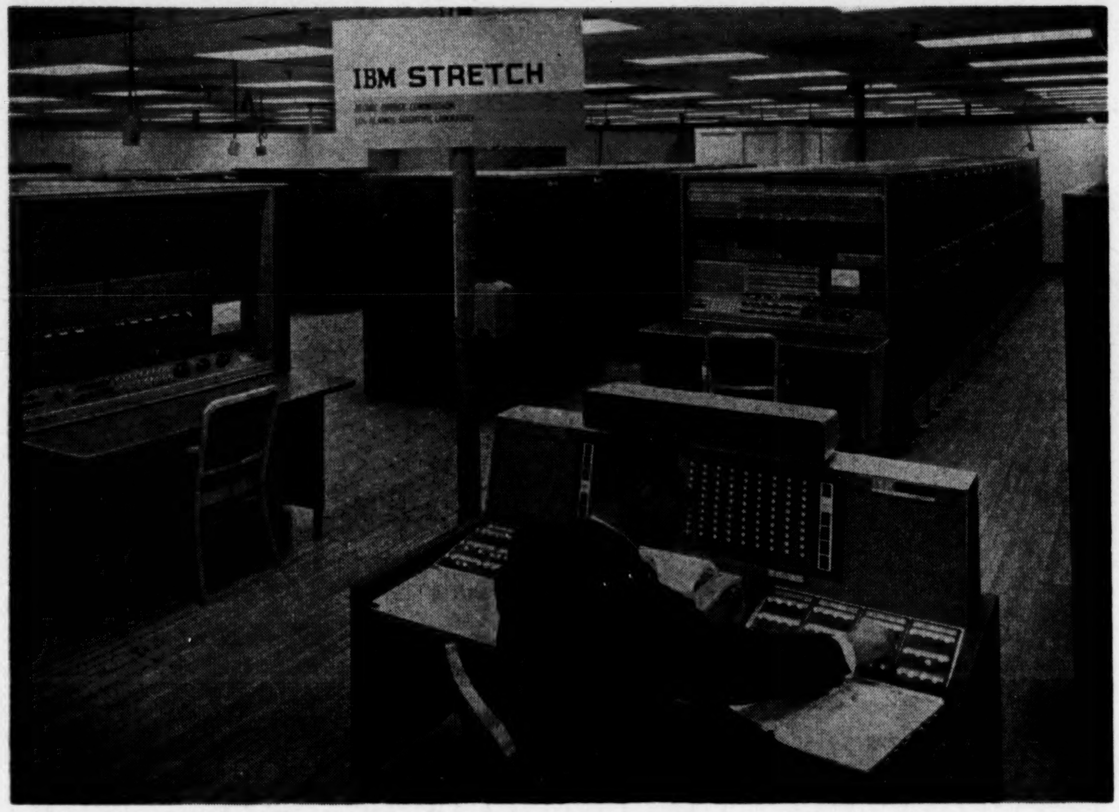
Washington—Results of a three-year survey of airline avionics equipment reliability provide valuable guidelines for avionic equipment designers, tube manufacturers and aircraft operators, including the military services. Many of the conclusions also are important to designers of transistorized avionics equipment.

In the carefully controlled three-year program, records of all reported malfunctions and their causes were obtained for three different types of VOR navigation receivers and two types of VHF communication receivers in operational use by six different airlines in the U. S. and Canada. The program and subsequent data analysis was conducted by Arinc Research Corp.

Additionally, the equipment used vacuum tubes produced by six different manufacturers, distributed among the different equipment makers and airlines. Although the original objective was to determine what improvement had been achieved in tube reliability since similar tests were made in 1952-1954, the program produced data of more widespread value.

Here are some of the more important findings, as revealed in an Arinc Research Corp. report based on an accumulated total of more than one-half million equipment operating hours and more than 10 million tube operating hours:

- **Mean-time-between-removals** due to operator complaints was 1,100 operating hours for VOR receivers, 570 hr. for communication receivers. This corresponds to one removal every three months for navigation receivers, one every two months for communication equipment.
- **Despite greater complexity of VOR** receiver, which has 27 tubes compared with only 17 tubes in the communication receiver, the navigation set exhibited nearly twice the mean-time-between-removal. This, coupled with other findings, indicates that it is much more difficult for a pilot to determine whether his communication receiver is operating properly than to determine whether his navigation receiver is operating properly. This suggests that avionic designers might develop means by which the pilot could check the performance of his communication equipment in flight, at least qualitatively, to reduce unnecessary removals.
- **Airlines lose two-thirds** the useful life of vacuum tubes by premature replacement due to perfectionist philosophy of their maintenance personnel and because of unwarranted removals of equipment upon pilot complaint. Arinc Research found that on the average airline maintenance personnel replaced still-operating tubes in equipment sent into the shop after 3,300 operating hours. These tubes had an average transconductance (figure-of-merit) only 14% below the original design value. If they had not been replaced until transconductance had dropped to minimum design value the airlines would have gained another 6,700 hr. of usable tube life, Arinc Research says.
- **Catastrophic failures**, which completely incapacitated an equipment, occurred less frequently with communi-



Computer Handles Nine Problems Simultaneously

Stretch computer, which can perform 30 billion multiplications in a 24-hr. period, is called world's most powerful computer by International Business Machines Corp. which developed machine for the Atomic Energy Commission's Los Alamos Laboratory. Computer will be used in nuclear weapon and Project Rover nuclear rocket engine studies. Stretch computer can handle up to nine different problems simultaneously, IBM says. Machine's high-speed memory consists of six magnetic core units, capable of storing 98,304 words with 72-bit length and providing access time of 2.1 microseconds. A super-speed memory provides 0.6 microsecond access time for frequently used data. Machine also has magnetic disk memory which can store 2,097,152 words, with access time of one second. Machine uses solid-state components throughout.

cation receivers than with VOR receivers, despite the much more frequent removals of the former. On the average, a catastrophic failure occurred only once for every six years of communication receiver operating service while navigation receivers averaged one such failure every 18 months of operation.

- **Greater variation in removal rates** exists among individual airlines than between different types of equipment. This indicates that maintenance practices can have a very great influence on reliability, a conclusion which is substantiated by earlier reliability evaluation programs for military avionics equipment.

No Criticism Intended

The Arinc Research Corp. findings are not intended as criticism either of flight crews or over-zealous maintenance personnel. The high number of communication equipment removals, compared with navigation set removals, is attributed to the pilot's critical dependence upon radio communications in addition to the fact that there is no cockpit failure indicator as there is for certain types of catastrophic failures in a VOR receiver. If the pilot calls a ground station and fails to receive a reply, he may think his equipment is at fault even if the real cause is improper adjustment of his own squelch control or reasons completely outside his own equipment.

The percentage of unnecessary communication receiver removals varies considerably among different airlines, ranging from a low of 13% to a high of 33%. The airline with the highest unnecessary removal rate was one that flies short routes with frequent landings, and its pilots make greatest use of communication equipment.

Removal Rates

Components	Removal Rate Per Million Operating Hours
Tubes:	
Open-Heater Failures:	9.5
Glass/Mechanical Failures:	2.9
Short Circuit Failures:	1.6
Capacitors:	0.31
Crystals:	0.34
Resistors:	0.15
Relays:	0.46*
Motors:	0.33*
Transformers:	0.96
Electromechanical Parts:	0.13
All Other Parts:	0.29

* Less than value shown

Nor does Arinc Research castigate the motives of airline maintenance men. When a set is returned to the shop with a report of unsatisfactory performance, even though there may not be anything wrong with the equipment, the conscientious maintenance man takes the opportunity to peak up equipment performance by replacing tubes which have deteriorated slightly, even though they still are within design limits, in an effort to prevent another removal in the near future.

Transistorized Equipment

However, Arinc Research warns that "these findings should be carefully considered in view of the rapid development of transistorized equipments [for airline use]. . . . If the present over-critical maintenance policies were applied to transistorized equipment, the cost of maintenance would be indefensibly high. . . ." (The number of transistors in a transistorized communication/navigation receiver usually exceeds the number of tubes in a conventional equipment, and individual transistors have been more costly than tubes.)

Although transistors do not deteriorate with use in the same way as do tubes, some of their characteristics do change gradually with time, particularly when operated at high temperatures, Arinc Research says.

This means that it is important for an avionic equipment designer to know the general shape of part-deterioration curves when he designs new equipment. Some components may exhibit a rapid and highly variable rate of deterioration in early operational life, later reaching a stable rate which is considerably slower. To prevent frequent removal and maintenance during early use, equipment circuits should be designed to accommodate this early deterioration.

Because of the variability of present transistor characteristics, Arinc Research says, avionic equipment designers should use plug-in sockets rather than solder transistors into place.

Because of the high percentage of tubes removed by airline maintenance personnel which were still good by original factory standards, the over-all tube removal rate is not a representative index of tube reliability, Arinc Research points out.

One type of tube failure, which causes catastrophic type equipment failures, is an open-circuited heater which was found in 7% of the total tube removals. However, these occurred in only three out of the 11 tube types (containing heaters) employed in the test program: Types 5654, 5751 and 5814. Of these, only the type 5814 failed to show marked improvement with respect to open-circuited heaters in later production quantities used in

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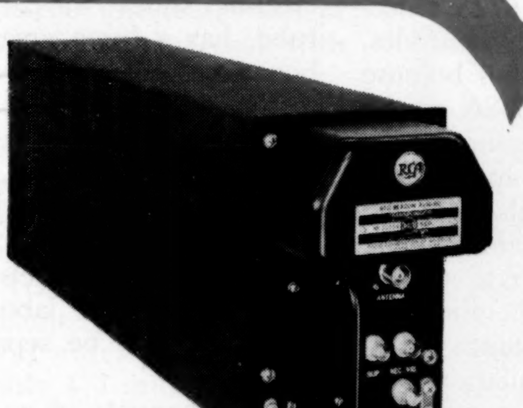

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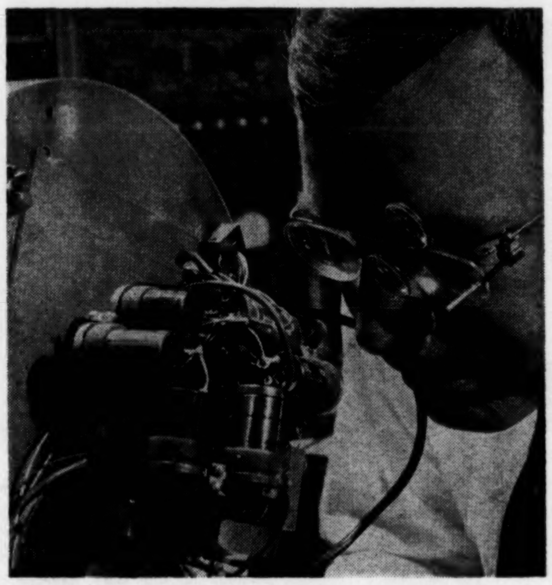


Three-Axis Accelerometer

Three-axis integrating accelerometer, developed by Sperry Gyroscope Co., can measure accelerations as small as one micro-g (one-millionth of a g), and as large as 30 g's, making it suitable for use in space vehicle or ICBM guidance. Device weighs 2 lb.

the test. The failure rate due to open-heater faults was 9.5 per million tube operating hours.

The removal rate for internal tube short circuits was only 1.6 per million hours of tube operation, and eight of the tube types operated for three years without a single internal short, Arinc Research reports. Most of the shorts occurred in Types 5654 and 5725, three-grid high-transconductance pentodes. The only double triode to fail because of internal shorts was the 6386, a relatively new type, and this may have been aggravated by its particular application.

Only 1½% of the removals were due to glass or external mechanical tube defects, giving a removal rate of 2.9 per million hours of tube operation.

Analysis of transconductance readings on tubes before installation and after removal, or termination of the test, disclosed that decay of tube transconductance was determined by interface resistance and pulse emission, Arinc Research says. Tube Types 5670 and 5654 were the most susceptible of the 11 tube types tested to interface resistance. Changes in transconductance due to pulse emission were less marked in high-transconductance tube types than in low-transconductance types.

In general, significant variations in quality of tubes between different manufacturers were not apparent in the test results because of the comparatively small number of tubes in the sample.

Although the workmanship and quality control of tubes now used in avionics equipment are very high, Arinc Research believes that the uniformity and long-life stability of tubes could be improved by greater control of saturation emission and interface resistance.

Even more important, however, is the problem of heater burnout, the largest single cause of major equipment failures. Arinc Research says that this problem could be eliminated, or greatly minimized, by closer cooperation between tube manufacturers and avionic equipment designers.

Detailed findings of the investigation, prepared by E. R. Jervis, are available as Report No. 411 for $1.00 from Arinc Research Corp., 1700 "K" St. N.W., Washington 6, D. C.

CalTech Calibrating 80-ft. Shock Tube

Pasadena, Calif.—Behavior of shock waves in gas densities equivalent to atmospheric pressures at altitudes of 60 to 70 mi. will be studied in a tube 80 ft. long and 17 in. in diameter at California Institute of Technology here.

The research, expected to help solve many aerodynamic problems in space and missile technology, will be supported by the National Aeronautics and Space Administration, which also funded construction of the $100,000 tube, located in CalTech's Guggenheim Aeronautics Laboratory.

The tube, now in the calibration phase, fires an initial blast equivalent to that of an intermediate ballistic missile with 50,000 lb. of thrust. The ensuing shock wave, confined in the tube, has a force greater than a sonic boom and travels up to Mach 8.0.

The tube has seven stainless steel sections, is enclosed at each end with inch-thick steel plates. Walls are one-half inch thick. The interior is highly polished. Joined sections are mounted individually on wheels on a track suspended from the laboratory ceiling so that they may be separated and interchanged.

Tube consists of a 12-ft.-long driver and 68-ft.-long test section, separated by a thin aluminum diaphragm, which is the triggering mechanism.

Air is pumped out of test section until pressure in it matches pressure of altitude of 60 to 70 mi. or one-millionth of sea level atmosphere. Gas—helium, argon or nitrogen—is pumped into driver up to 10 times atmospheric pressure.

Pressure differential forces diaphragm to bulge into test section side and press against a knife-edge cross arched to fit curve of diaphragm's bulge until blades slice diaphragm into four pie-shaped wedges, releasing gas into vacuum and pressing aluminum wedges against tube walls. Released pressure creates shock wave that moves the length of test section in one-hundredth of a second. Wave may oscillate back and forth the length of tube or can be damped out.

FILTER CENTER

▶ **Improved Solar Cell**—New solar cell with improved response in blue region of visible spectrum may provide higher efficiency, or better power output per solar cell panel, in space, according to Hoffman Electronics Corp. Normally, solar cell panels experience a 25% drop from rated efficiency when they are in space; the new cell may fall only 10 or 15% below laboratory rating, the company says. This means that a solar cell, rated 12% efficient, might in fact convert solar to electrical energy at an efficiency in excess of 10% in space. The improvement is partially made possible by a solar simulator which more closely reproduces solar spectral characteristics in space than did the tungsten light which was the earlier standard.

▶ **New Roles for Opti-Masers**—Extremely narrow beamwidth and nonchromaticity of optical masers (optimasers) suggests a variety of new aerospace applications, including prelaunch alignment of gyros in missile guidance systems, John G. Atwood reported at recent Perkin-Elmer Corp.-sponsored symposium. Atwood, director of research for company's Instrument Division, predicted that the next decade would see 10 to 20 different types of optical masers on the market, each with different characteristics.

▶ **Powerful Magnet Demonstrated**—Continuous magnetic field of 126,000 gauss, roughly 500,000 times the strength of the earth's magnetic field, has been generated by the Massachusetts Institute of Technology under tri-service sponsorship. The magnet requires 320 gal. of water per minute for cooling and nearly 1.9 million watts of electric power. Another high-power magnet under development by MIT is expected to produce 250,000 gauss. The magnet was built by High Voltage Engineering Corp., Burlington, Mass. for MIT.

▶ **Thin Film Thermoelectrics**—General Dynamics/Astronautics is studying the conversion of solar into electrical energy by the use of thin films of thermoelectric materials, rather than conventional thermoelements. Films of thermoelectric materials are expected to yield converters with better efficiencies and power densities than those made with solar cell films which the company also is studying as part of thin film solar energy conversion research program.

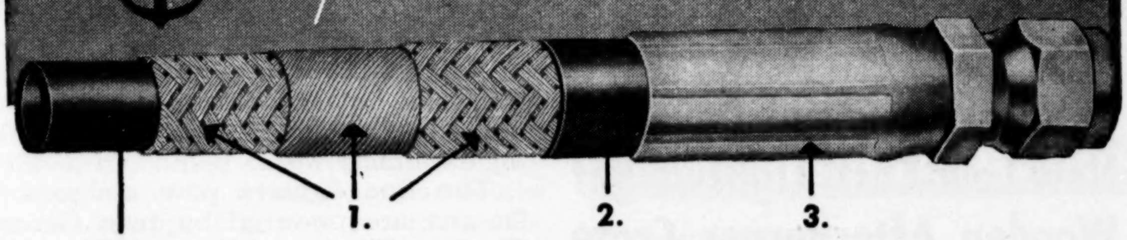
▶ **Microminiature Inductors** — Coils in values up to a millihenry are being made by Motorola for the Navy's Bureau of Ships. The micro-sized elements are fabricated on magnetic or non-mag-

A NEW DIMENSION AT
GIANNINI CONTROLS:
SPACEFRAME
RESEARCH

Research in vehicle dynamics, flight control, and associated operations research now deepens technology at Giannini Controls Corporation. ■. The awarding of three significant contracts to the new Astromechanics Research Division of Giannini Controls has established a solid backlog as well as professional acceptance. Potential is up to the competence of the staff—present and future. Recognition emphasizes individual technical performance in a team context. ■ The division has moved into the Philadelphia Main Line area as permanent home. Our staff of research-oriented aerospace engineers and scientists has the best possible opportunity for growth at all levels under Division Manager Melvin B. Zisfein.

Giannini Controls Corporation 1600 South Mountain Avenue, Duarte, California
A NAME TO PLAN WITH
GCC 1-33

NEW from ANCHOR®
hdp Hose Assemblies for Aircraft, Missile H.P. Pneumatic Servicing



hdp high density polyethylene inner tube

50 ft. lengths can be fabricated! Polyethylene is easy to clean and is highly resistant to the effusion of gases.

1. Braid and spiral plies are of stainless steel for maximum corrosion resistance.

2. Neoprene cover to withstand rough handling and exposure.

3. Anchor exclusive stainless steel, ductile sleeve swaged couplings are leak-proof and permanent! Couplings have 37° female swivel nuts to mate with MS33656 fitting ends.

The Anchor **hdp** Hose Assemblies fully conform to MIL-H-26666A (USAF) specifications: Available in the -4, -8, -12 size for *4,000 PSI W.P.* and in the -6 size for *6000 PSI W.P.* Temperature range -65°F to +160°F for service with any inert gas. Request our new MIL-SPEC. CATALOG now!

ANCHOR Coupling Co. Inc.
333 North Fourth Street Libertyville, Illinois
Branch Plants: Dallas, Tex., Plymouth, Mich.

Flight Propulsion

Convair 990 Hits Mach .97 During Speed Test Flight

SAN DIEGO, Calif.—Convair's 990 Coronado jet airliner recently logged speeds of Mach .97 during test flights over the Pacific.

This is the fastest true air speed ever attained by a commercial jet transport.

Powered by four General Electric CJ-805-23 aft-turbofan engines rated at 16,100 pounds thrust each, the 990 reached a maximum speed of 675 mph at 22,000 ft.

The high-speed test flight saw the 990 dive at Mach .97 from an altitude of 32,000 ft. to 22,500 ft. The flight was made to demonstrate a "cushion" between the operating speed and the airplane's capability.

In earlier tests, the 990 jet airliner passed a series of demonstrations designed to increase its maximum permissible landing weight. Ship 1 landed at Edwards Air Force Base at a weight of 192,000 pounds, 12,000 pounds heavier than the 180,000 pounds specified for the aircraft.

This performance will permit more flexible medium range operations, making possible a longer series of short stage lengths without refueling.

A medium/long range jet capable of operating from 5000-ft. runways, the 990 is designed to carry from 96 to 121 passengers. It is expected to cut transcontinental non-stop flight time by as much as forty-five minutes.

The 990's turbofan engines are equipped with the same G-E constant speed drives that have been proven in service aboard the turbojet 880.

Convair 990 Coronado jet airliner on high-speed test flight. CJ-805-23 powered aircraft flew at Mach .97, fastest true airspeed ever attained by a jet transport.

General Electric Develops New Low-Cost, Lightweight Wooden Afterburner Crate

CINCINNATI, Ohio—Package design experts at General Electric's Large Jet Engine Department have developed a new low-cost wooden container for shipping J79 afterburners.

The new container, which was developed in conjunction with the U.S. Air Force, weighs only one-eighth as much as metal containers previously used.

Designed in the Product Support Section of the Large Jet Engine Department, the container weighs only 237 pounds, compared to 1800 pounds for the metal container. Lightweight and durable, the wooden afterburner crate meets all Air Force and Navy requirements.

Appreciable savings in shipping and material costs have been effected as a result of the new container, and need for keeping extensive records on non-disposable metal cans is eliminated.

FIRST McDONNELL F4H PHANTOM II'S ARRIVE AT OCEANA NAVAL AIR STATION

NAS OCEANA, Va.—Five McDonnell F4H "Phantom II's" were recently transferred here from NAS Miramar, Calif., to join U.S. Navy Fighter Squadron 101. VF-101 is the second USN unit to conduct training with the Mach 2 all-weather fighter.

At Miramar, Fighter Squadron 121 has been training F4H pilots since February. The Navy will continue F4H training at both air stations, with the first operational squadron of "Phantom II's" slated for fleet service in the near future.

Reports from pilots and maintenance personnel at Miramar indicate that both aircraft and engine are performing extremely well.

The five fighters now assigned to Oceana are powered by twin General Electric J79-2 turbojets, rated in the 16,000-pound thrust class. Production F4H's now being delivered to the Navy use G.E.'s J79-8, a more powerful version of the "-2."

Power for the aircraft's parallel operating electrical system is provided by two G-E constant speed drives, each rated at 20-kva capacity.

Destined to become the Navy's standard Mach 2 carrier-based fighter, the McDonnell "Phantom II" has already demonstrated its operational capabilities by flying to an altitude of over 98,500 feet and setting two world speed records. On September 5, 1960 an F4H-1 logged 1216.78 mph in a 500-kilometer closed-course run, bettering the former record by more than 400 mph. Three weeks later another F4H-1 set a new 100 kilometer world speed mark of 1390.21 mph.

Official photograph U.S. Navy

First of five J79-powered McDonnell F4H's arrives at NAS Oceana from the West Coast.

NEWS

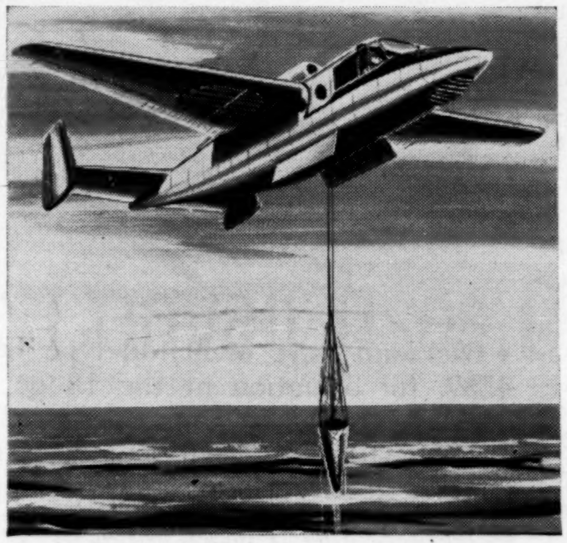
A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

General Electric Studies Lift-fan Powered VTOL Craft for Retrieving Team

CINCINNATI, Ohio—A lift-fan powered VTOL transport which could become part of a "mother-daughter" team for retrieving valuable payloads is currently under study by the General Electric Company.

The new "daughter" VTOL aircraft would operate with a "mother" C-130 or equivalent, and provide global rescue of personnel and recovery of payloads up to 3600 pounds.

The daughter aircraft would have a gross weight of 13,000 pounds and a maximum speed in excess of 450 knots. General Electric X353-5 lift fans will power the aircraft. The lift fans would be installed at an angle of 10 degrees from the vertical centerline of the daughter aircraft to reduce downwash in the pickup area.



Drawing of G-E lift-fan powered "daughter" recovering a payload from ocean.

To begin a rescue mission, the two aircraft would take off separately. After reaching moderate altitude, the daughter aircraft would hook-up with the mother and be flown to the mission area. The daughter then would detach, descend, retrieve the payload, and fly back to the mother aircraft for reattachment and return trip.

During return flight to the base, the cargo or personnel might be transferred to the mother aircraft through a pressurized hatch. Upon reaching the landing area, the daughter would again separate from the mother, and the two would make separate landings.

The "mother-daughter" method of accomplishing search and retrieval missions takes advantage of the VTOL and high speed capabilities of the lift-fan powered daughter, and the long-range abilities of the C-130 transport.

In addition, the "daughter" will operate alone as an efficient short-range retrieval aircraft.

Spotters on ground check air speed of HSS-2 as it breaks helicopter world speed record.

T58® POWERED HSS-2 RECAPTURES HELICOPTER RECORD FROM RUSSIANS

WASHINGTON, D. C.—A new helicopter world speed record of 192.9 mph was established May 18 by a U.S. Navy Sikorsky HSS-2 turbocopter over a three kilometer (1.86 miles) straight course at Windsor Locks, Conn.

Powered by two General Electric T58 gas turbine engines, the boat-hulled HSS-2 joins the fleet this year as a submarine hunter-killer.

The fastest speed previously flown by a helicopter was 167.09 mph by a Russian Mil-6, November 21, 1959 over a closed hundred kilometer (62 mile) course. On May 24 the Sikorsky HSS-2 reclaimed this record from the Soviet Union by flying a similar course at 174.9 mph. The new record is subject to confirmation by the Federal Aeronautique Internationale.

The HSS-2 is a key weapon in the nation's anti-submarine warfare defenses. Designed and developed as a weapon system with multi-mission capability, the HSS-2 is the first Navy 'copter able to detect, identify, track, and destroy enemy submarines.

The HSS-2 has "round-the-clock" operational capability. Amphibious hull, turbine reliability, integral search and attack equipment and record-breaking speed give it performance that far surpasses present piston-engine anti-submarine warfare helicopters.

The General Electric T58 powerplants, major contributors to this outstanding performance, each produce 1250 horsepower and weigh only 295 pounds. Operating on only one of its twin T58's, the HSS-2, at normal ASW mission weight, can continue to fly using the military 30-minute power rating.

The T58 also powers the Kaman HU2K, and Boeing-Vertol HRB-1. The CT58, civil version of the engine, powers the Sikorsky S-61 and S-62 and the Boeing-Vertol 107.

FOR FREE INFORMATION

General Electric Company
Section 206-38A, Schenectady 5, New York

- ☐ GED-4106, "F4H/J79"
- ☐ GED-4460, "HSS-2/T58"
- ☐ GED-6002, "CJ-805"
- ☐ GER-1704, "F4H Electrical System"
- ☐ GEA-6890, "Constant Speed Drives"
- ☐ GED-4509, "Search and Retrieval Mission"

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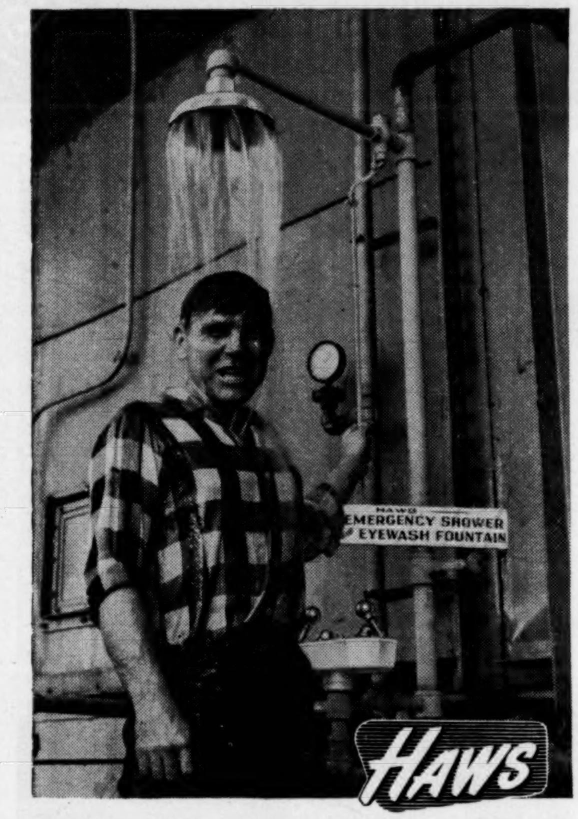

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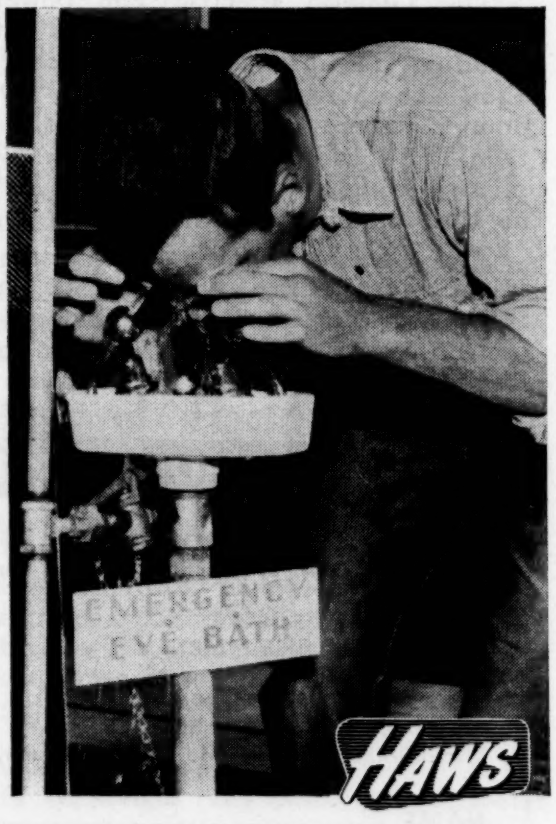

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A Haws Eye-Wash Fountain instantly sends soothing water into injured eyes to wash away volatile fuels and acids. Accidents happen—but you can prevent serious damage. Write today for Haws fully detailed safety catalog. HAWS DRINKING FAUCET CO., *Fourth & Page Streets, Berkeley 10, California.*

netic substrates by combination of vacuum evaporation and electroplating techniques. The spirals are about 10 mils thick. Air core inductors deposited on 270-mil-diameter substrate have possessed inductances of 2 microhenrys, Qs of 62 at 60 mc.

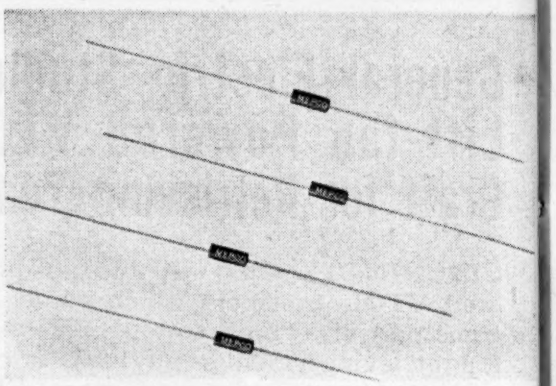
▶ **Solar Cell Covers**—Glass covers with thin film interference filters vacuum deposited on their surfaces are being made by Optical Coating Laboratory, Inc., to improve operation of solar cells in space. When fitted over solar cells, the blue-red reflecting solar cell covers will reject solar radiation outside the 0.4- to 1.1-micron wavelength region usable in the energy conversion process. Covers will reduce unnecessary heating of the cell, protect the cell from damage and erosion by micrometeoroids. Optical Coating Laboratory is located at 2789 Giffen Ave., Santa Rosa, Calif.

▶ **Lightweight Daylight Star Tracker**—A 10-lb. electronic star tracker capable of achieving pointing accuracies of better than ½ sec. of arc with 40 in. focal-length optics has been developed by Librascope Division of General Precision, Inc. Indicated weight does not include batteries (4 watts are required), servo amplifiers and angle encoders. Tracker employs special photomultiplier tube as a sensor, measures about 4 in. in diameter and 13 in. in length.

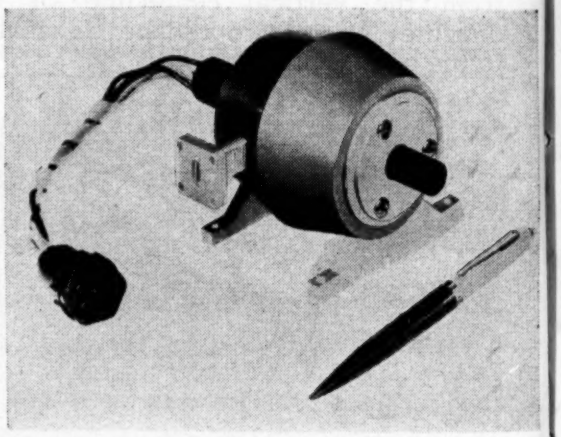
▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

- **General Precision,** Tarrytown, N. Y., has received a contract from Martin-Denver for study of guidance system requirements for Space Logistics Maintenance and Rescue Vehicle (Slomar), which Martin is studying under USAF contract.
- **Sylvania Electric Products,** Applied Research Laboratory, will study fluctuations of the earth's magnetic field and its relationship to causes of violent electric storms, sun spots and solar flares, under $45,000 contract from USAF Cambridge Research Laboratories.
- **Collins Radio Co.,** Cedar Rapids, Iowa, $1.05-million Air Force contract for VHF communications systems to be used on Globemaster and Hercules aircraft. Company also reports $102,626 add-on contract from Jet Propulsion Laboratory for installation and maintenance engineering assistance at JPL's deep space instrumentation facility in Johannesburg, South Africa.
- **Westinghouse Electric,** Aerospace Electrical Department, Lima, Ohio, $50,000 study contract from USAF's Aeronautical Systems Division, Dayton, for a 4 kw. solar-cell power system for space vehicle use, designed to provide minimum life of one year.

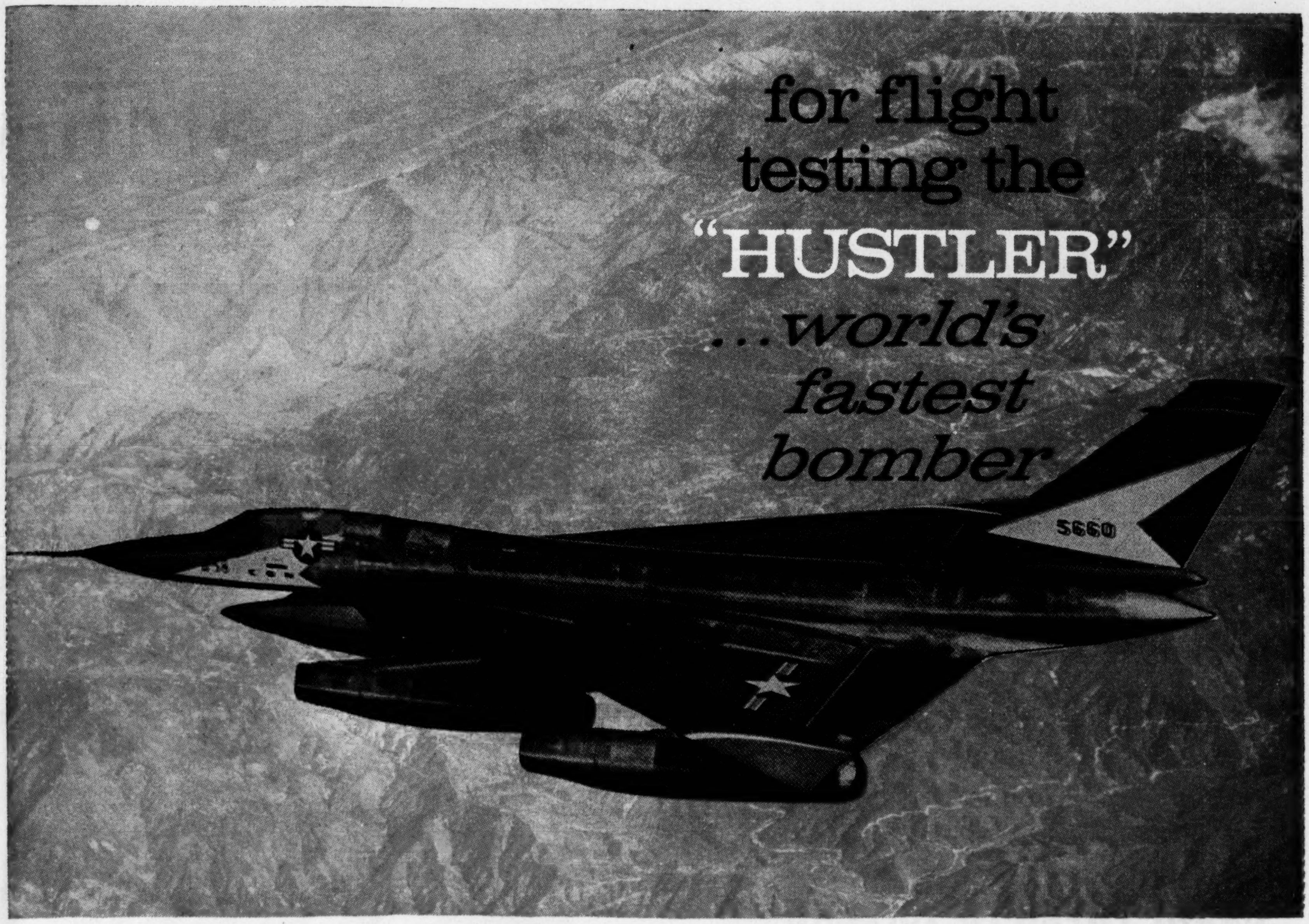
NEW AVIONIC PRODUCTS



- **Film resistor,** Model EM 10, a carbon film resistor enclosed in a molded diallyl phthalate jacket is available in resistance range from 10,000 to 100,000 ohms (1% tolerance), rated 1/10 watt at 70C. The resistor meets requirements of MIL-R-10509C, measures 270 mils in length and 110 mils in diameter and has 1.5 in. axial leads of #26 AWG wire. Manufacturer: MEPCO, Inc., 37 Abbett Ave., Morristown, N. J.



- **Backward wave oscillator,** type BW-4289, for operation in the 18 gc. to 26.5 gc. frequency range, designed as a voltage-tunable signal source for microwave receiver local oscillator applications, test equipment and signal generating equipment. Tube is 5 in. long, 3½ in. in diameter and weighs 5 lb. including a permanent magnet which focuses the beam. Minimum power output from the tube is 5 milliwatts. Price for a single tube is approximately $3,000. Manufacturer: Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.
- **Servoed accelerometers,** PAL-1S and PAL-1P series, completely self-contained accelerometers containing subminiature amplifier, deliver high level signals for telemetry, control or measurement to accuracy of 0.1%. Power requirement is ¼ watt. Manufacturer: Palomar Scientific Corp., Palo Alto, Calif.
- **Cryogenic measuring systems,** which include fast response germanium thermometers and special "servo/riter" potentiometric recorders, are available for low temperature (helium and hydrogen ranges) measuring applications. Thermometers are of three types—calibrated,



Convair uses DORSETT Telemetry Equipment

MACH 2-PLUS SPEEDS and service ceiling above 60,000 feet are just two in literally hundreds of radically new innovations Convair/Fort Worth engineers specified for the Air Force B-58 . . . already holder of many world speed records!

Yet, each unique device was already a proven unit, from the J-79 jet engines to the bonded-sandwich wing panels. Despite such fantastic demands, Convair flight-tested the first "Hustler" just *26 months* from release of engineering drawings!

Test schedules for this unprecedented assembly of "new" components require unquestionable accuracy in telemetering equipment. Dorsett, a major supplier of subcarrier oscillators to Convair/Fort Worth for over four years, filled (and continues to meet), the requirements for as many as 500 subcarrier oscillators per test plane! The Dorsett Model 0-3 is used in pre-assembled multiple unit banks. The Dorsett Model 0-28 transistorized voltage controlled oscillator is used for special test situations.

Be sure to include DORSETT on your Vendors' list for telemetry systems and components, including: Subcarrier Oscillators, Transmitters, Mixer-Amplifiers, Voltage Regulators, Power Supplies, Keyers and System Packaging.

DORSETT ELECTRONICS, INC.
P.O. BOX 862 • NORMAN, OKLAHOMA • JEFFERSON 4-3750

This is systems capabilit a

Many of the significant advances in electromechanics, electronics systems, environment systems, and other areas, were originated and brought to fruition at the Columbus Division of North American Aviation. A complete center of advanced systems technology, the Columbus Division has the minds and facilities to convert original concepts into practical hardware with economy and efficiency. This is true systems capability... this is the Columbus Division.

COLUMBUS DIVISION OF
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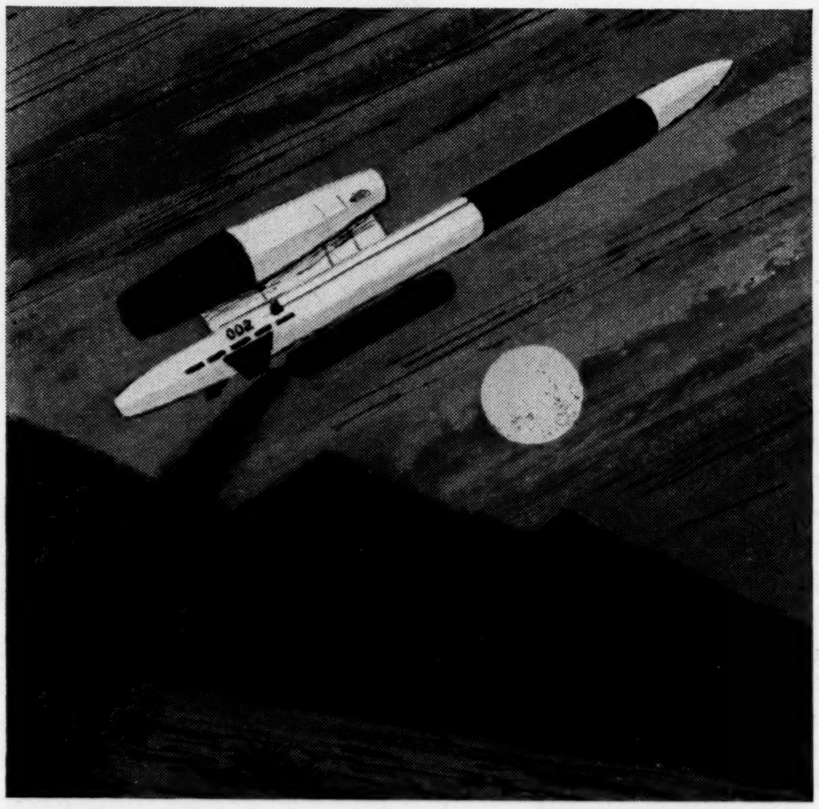
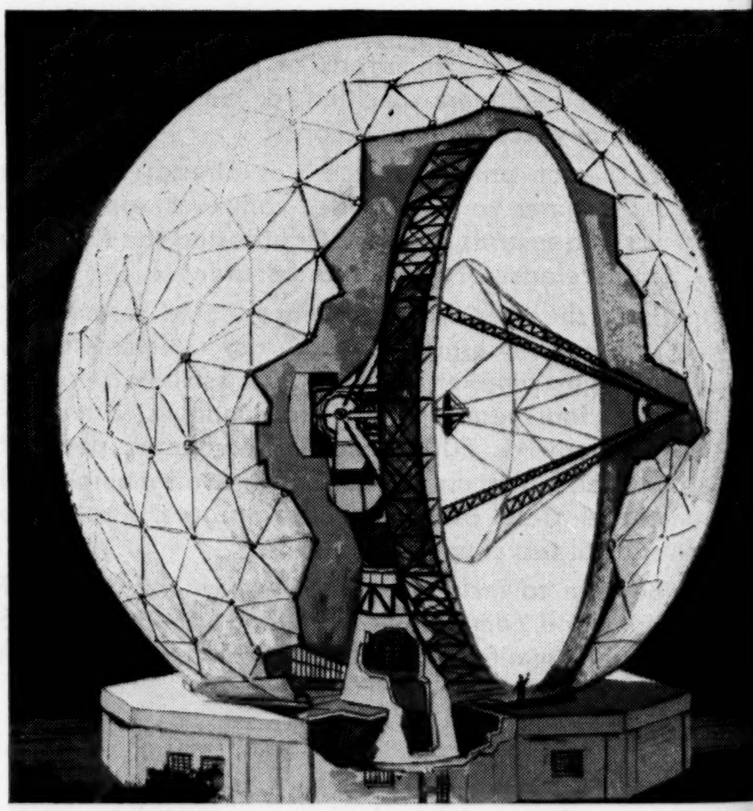


DOUBLE DUTY. NAA-Columbus is building the complete Army Redhead-Roadrunner target missile system. This economical new missile will fly subsonic or supersonic missions and will operate at altitudes up to 60,000 feet.



"HAYSTACK HILL" ANTENNA. A 120-ft. antenna system using a new concept that distributes tension evenly to avoid distortions in readings, is being built by Columbus for USAF on Haystack Hill near Boston, Mass

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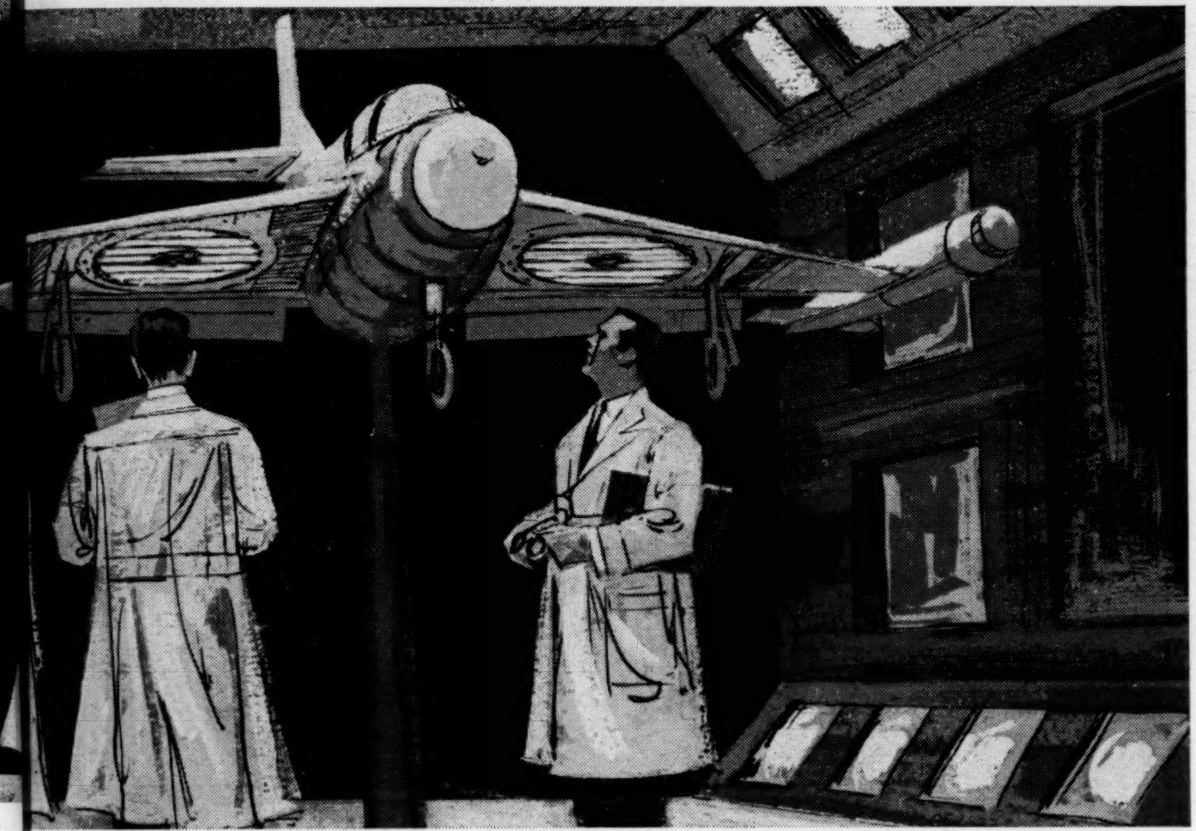
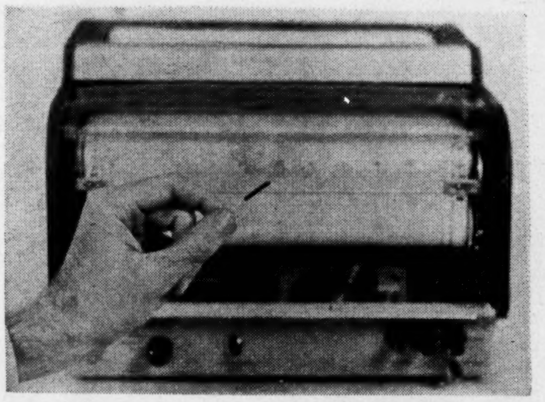
at NAA-Columbus

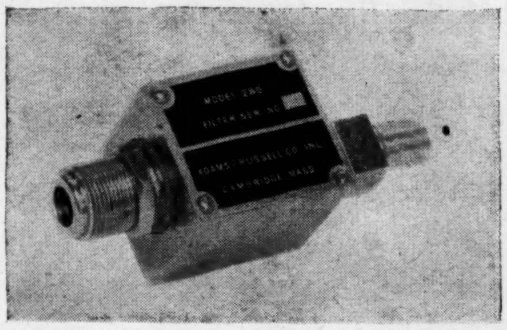


V/STOL FACILITIES. NAA-Columbus has one of the largest wind tunnel V/STOL design testing sections in the world (14 feet wide by 16 feet high). This is part of the extensive V/STOL facilities Columbus has used in the development of both lift-fan and tilt-wing aircraft which need no runway for take-off or landing.

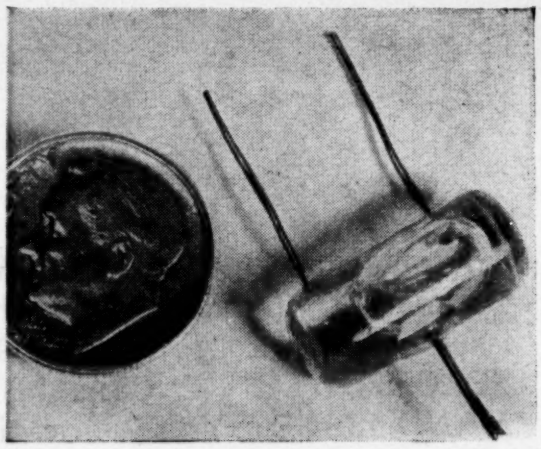
ANTI-SUBMARINE WARFARE. NAA-Columbus is at work on new applications of anti-submarine warfare to meet the threat of highly advanced submarines. Other research and development projects at Columbus include advanced battlefield surveillance, and surface-to-air and surface-to-surface missile systems.



uncalibrated and standardized. Recorders can be converted to standard d.c. recording. Manufacturer: Texas Instruments, Inc., P. O. Box 6027, Houston 6, Tex.



• **UHF Harmonic Filter,** Model 280, eliminates harmonics of 215 to 260 mc. telemetry transmitters in aircraft and missile applications. The 4-oz. filter is designed as the RF output fitting for a pressure tight transmitter. Filter's pass band is zero to 320 mc., insertion loss is less than ½ db. below 260 mc., 50 db. above 450 mc., vswr is 1.5 below 260 mc., power rating is 50 watts. Priced at $135 each in small quantities, the filter can be obtained from manufacturer, Adams-Russell Co., Inc., 200 Sixth St., Cambridge 42, Mass.



• **Vertical sensing element,** Model 228571-1, a single axis, snap action, electrolytic unit which can drive torque motors directly without requiring amplifiers is being added to a series of subminiature vertical sensing elements. The "on-off" instrument cannot be nulled, has tilt angle of 0.75 deg. (plus 30 arc minutes spread from full scale in one direction to full scale in the opposite direction), 18 v. differential output voltage and 18 ma. max. current through either contact. Manufacturer: Kearfott Division, General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

On September 25, AVIATION WEEK and Space Technology will publish one of the most important issues in its history . . . "FORGING MILITARY SPACEPOWER" – USAF SYSTEMS COMMAND ISSUE. For the first time, the complete story of the newly activated USAF Systems Command will be presented to the aerospace industry throughout the world.

The new Systems Command will serve as a single agency to control R&D and procurement of all aircraft, missile, avionic and space systems for the USAF from the idea stage through the time they are in the field ready for use. This concept of a single agency for both systems R&D and systems procurement will have penetrating impact on all aerospace industry companies selling hardware or research services to the Air Force.

The Systems Command will control approximately $15 billion in contracts and annually will award $7-8 billion in new contracts making it the most important single source of aerospace industry business. Further evidence of the impact on industry are policy and procedure changes which can be expected in many areas such as technical approach, contract competition, proposals, cost estimating, management structure and subcontracting.

These are just a few of the important details to be covered in the Systems Command Issue, which will constitute a new handbook in doing business with the Air Force. Teams of AVIATION WEEK editors are now visiting the various bases of the Command for full, complete reports. Detailed edi-

MILITARY SPACEPOWER”

USAF SYSTEMS COMMAND ISSUE

SEPTEMBER 25, 1961

torial coverage will be given to procurement, organization, plans and programs, policies, procedures and future technical activities.

AVIATION WEEK is privileged to present this edition to the industry covering our newest and vitally important Command. Prime contractors, subcontractors, suppliers and firms doing R&D work for the Air Force will be extremely interested in this new issue which will lay the groundwork for future contacts with the Command. It will supersede all previous editions on USAF research, development and procurement policies.

Your company is urged to participate by advertising its capabilities and facilities for the furtherance of the defense effort. Write, wire or call collect for space reservations.

Aviation Week
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TRW **TAPCO**

A DIVISION OF THOMPSON RAMO WOOLDRIDGE INC.

23555 EUCLID AVENUE, CLEVELAND 17, OHIO

The calling card of subcontractor versatility TAPCO is a major facility offering research, design, development and production of systems, subsystems and components to the missile, aircraft, ordnance, marine, electronic and nucleonic industries. Proof of the quality and advanced nature of TAPCO capabilities lies within such prominent programs as SNAP, Sunflower, Pershing, Bomarc, Terrier, Tartar, Polaris, Minuteman, F-105, B-58, B-70, X-15, Mercury, Dyna-Soar. **ADVANCED ENERGY CONVERSION SYSTEMS:** Closed-cycle Rankine turboelectric (water, mercury, potassium, organic); turbine APU's; MHD; thermionic; fuel cell. Energy sources employed include solar, nuclear reactor, stored thermal energy, chemical and cryogenic fuels. **ADVANCED PROPULSION:** Arc ion rockets; plasma accelerators; ion propellant feed systems; reaction flight control systems; attitude control systems; vector nozzles; vernier rockets. **ADVANCED ELECTRIC POWER GENERATION AND CONTROL:** Brushless alternator and static circuit systems operating from any energy source and in ambients to 1000F. Analog/digital servo subsystems. Static standby power supplies for uninterrupted transfer of power. **INTEGRATED ENVIRONMENTAL CONTROL:** Space vehicle temperature control; space vehicle atmosphere control; closed-cycle oxygen regeneration. **MISSILE LAUNCH AND SUPPORT:** Mobile, air-portable transporter-erector-launcher vehicles; integrated launching and control systems; special airborne and ground test equipment. **UNDERSEA SYSTEMS:** Propulsion and control; submarine detection systems; drag reduction; hydrogen generation; special hydrodynamic studies. **FLUID SYSTEMS:** Aircraft engine-driven, booster and after-burner fuel pumps; flow control and relief valves; linear and rotary hydraulic actuators. Cryogenic fluid systems; hot-gas servo systems. **SPECIAL INSTRUMENT PRODUCTS:** Weather and gas line instrumentation; precision magnetic storage devices; signal-conditioning subsystems. **FM VIDEO TELEMETRY SYSTEMS:** Broad-band transmitters and receivers; multiplexing; subcarrier channels; automatic servo-controlled tracking. **MATERIALS TECHNOLOGY:** Develop extrusion, forging, welding and coating processes for superalloys and refractory metals. Study liquid-metal corrosion. Perform applied research and application engineering for plastics, ceramics, high-strength metals and refractory metals for hot-gas servos, rocket-engine components, high-temperature motors and unusual power-generating equipment.

Gyro Autopilot Needs No Electric Input

By William S. Reed

Los Angeles—Pneumatically operated, single gyro-flight control system for aircraft up to light-twin size is being marketed by Brittain Industries, Inc., following five years of development, including two years of testing in the field.

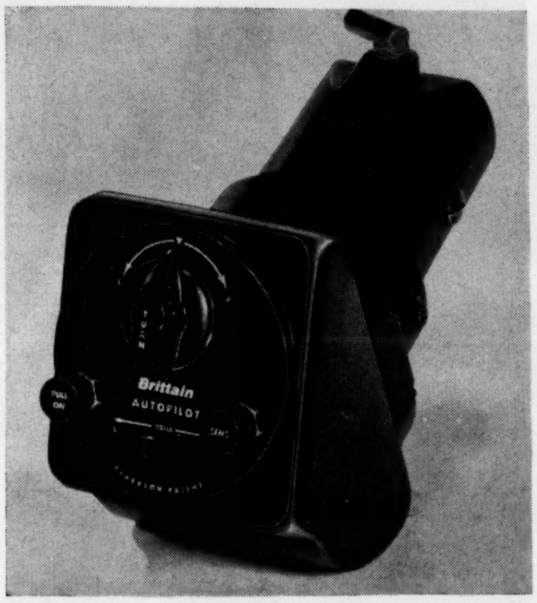
Depending on vacuum supplied by an engine driven pump, or a specially designed venturi, the Brittain flight control provides precise heading hold, and wings level attitude control without any electrical or electronic inputs or outputs.

The autopilot, flown by this Aviation Week pilot in a Piper Comanche 250 owned by Brittain President Karl Frudenfeld, M.D., was found to hold heading with fine accuracy. Control approached in smoothness that exercised by a human pilot. Unlike some automatic flight devices, the Brittain unit applies smooth, proportional force to the controls rather than jerky motions.

Sensing element of the system is a gyro similar to that found in a turn and slip indicator and possessing the same reliability inherent in that instrument, Frudenfeld contends. The gyro, utilizing the principles of inertial guidance, is inclined at an angle varying from 35 to 40 deg. to the longitudinal axis of the aircraft. Exact angle of mounting depends on the type of aircraft in which the installation is made. By having the correct angulation, variations in both yaw and roll are sensed by the single gyro. The complete sensing element is mounted in the control head which contains a universal mounting adapter for the instrument panel.

Control actuators are neoprene-sealed cylinder and piston combinations which by the nature of their function do not have to be constructed with any great precision. Tolerance in the fit between piston and cylinder is about ½ in. with the neoprene membrane forming a seal.

Again depending on the installation, separate actuators are supplied for lateral and directional control or a single proportional actuator can be used where there is a tie-in between rudder and aileron. Short lengths of cable connect the actuators to the control cables. With the system turned off, the connecting cables are slack and create no binding on the controls for manual operation. Slack is equalized when vacuum is applied to the system.



GUIDANCE ELEMENT of the two-axis Brittain pneumatic autopilot is mounted on the instrument panel. Note the angle of the gyro housing which enables the single gyro to sense movement in both the lateral and directional axes. Full deflection of the turn knob produces a 2 min. turn.

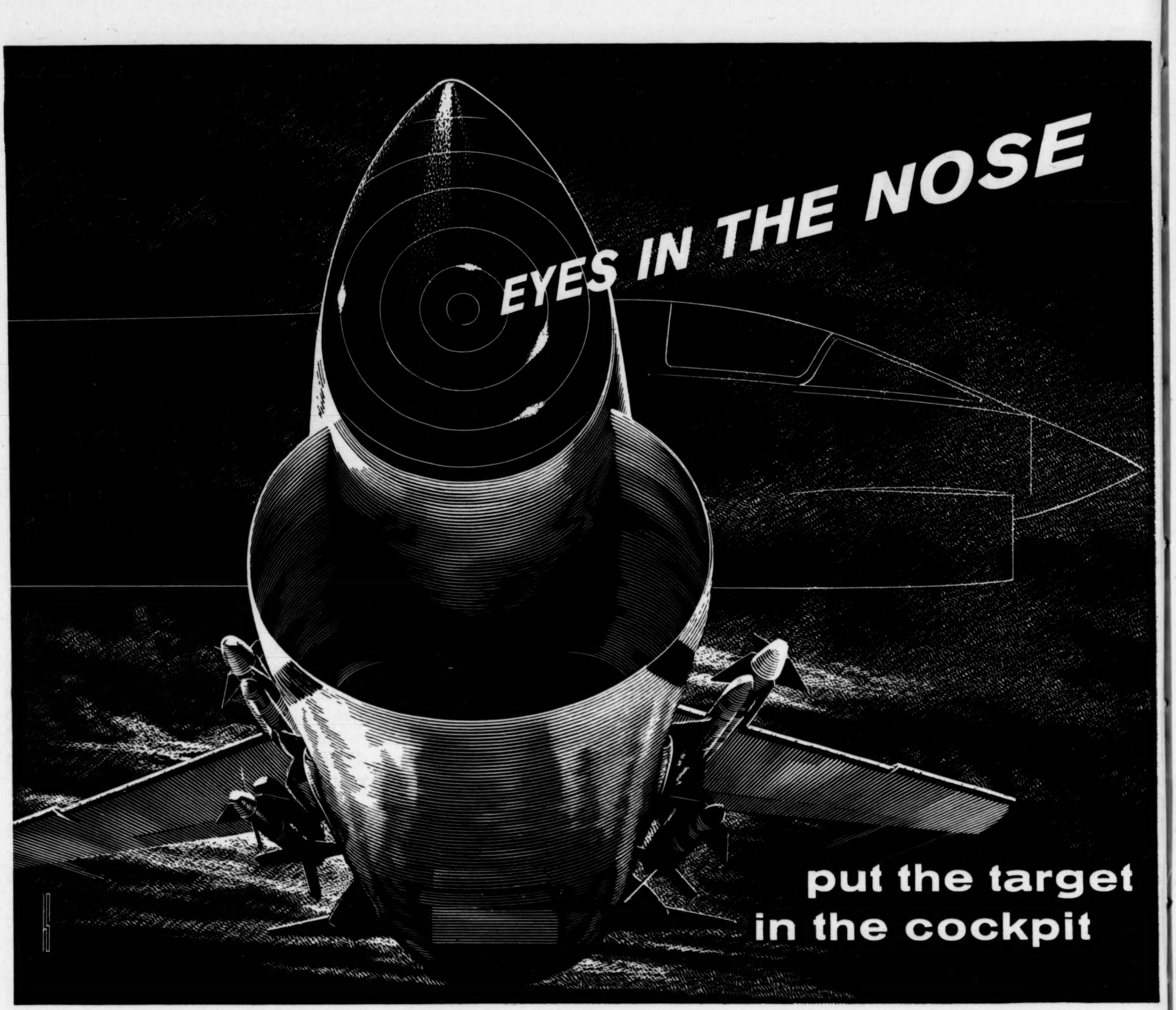
No panic switch is necessary for the control wheel for disconnect of the system in the event of manual flight. Pressure is equalized on the actuators unless the sensing signal gives a command. Therefore, effects of the autopilot are barely perceptible when the system must be overpowered by the pilot. During Aviation Week's flight in the Comanche, a landing was made with the system on and no difference was noted in handling qualities.

Another feature normally not found in light-aircraft autopilots is the usefulness of the Brittain in rough air. Sensitivity of the unit can be decreased in rough air as was experienced in flying over the mountains along the Pacific Coast during the demonstration. Because of the "softness" of control inputs, overstressing of the control surfaces and structure was not imminent. Nor is there any tendency of the unit to spill since there are no bank or yaw limits to the degree of effectiveness of the gyro. It can be used to recover from steep banks, spiral descents or other unusual positions.

The Brittain unit is completely separate from the gyro horizon and directional gyro of the aircraft's flight instruments. An inoperative panel instrument does not mean an inoperative

Swedish Aircraft Features Sandwich Construction

AB Malmo Flygindustri has demonstrated a prototype of a Swedish four-seater high-wing light aircraft for civil and military use, designated MFI-10 Vipan. Developed in collaboration with Saab Aircraft Co., the Vipan features a sandwich construction of two bearing shells of aluminum alloy with honeycomb aluminum spacers for the fuselage, wings and control surfaces as well as a glass fiber reinforced plastic landing gear. The Vipan has a maximum speed of 150 mph. and a rate of climb of 960 fpm.

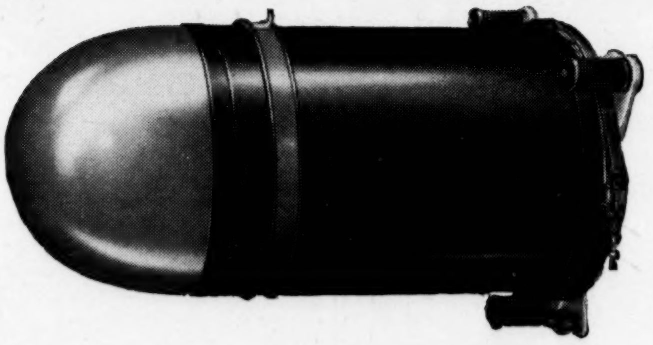


As a result of development by the Magnavox Company in conjunction with the Navy Department, every Chance Vought F8U-2N Crusader Fighter Pilot sees the target at a glance—day or night, in any kind of weather.

Here are the eyes of a modern weapons system . . . a component that delivers the range, weight and reliability so absolutely necessary to successful tactical operations.

This airborne radar system is just one of many systems which have been and are being designed and produced to satisfy the tactical requirements of the military services in the fields of Communications, Airborne Radar, ASW, Navigation, Fusing and Data Handling.

Magnavox



AIRBORNE FIRE CONTROL RADAR

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THE MAGNAVOX CO. • DEPT. 413 • *Government and Industrial Division* **• FORT WAYNE, IND.**

U.S. Business & Utility Aircraft Shipments

May, 1961

Make & Model	No. of Units	Factory Net Billing
Aero Commander 500A, E	7	$843,000
560F	4	
680E, F	1	
Beech 18 Super	3	$2,854,000
33 Debonair	11	
35 Bonanza	24	
50 Twin-Bonanza	3	
55 Baron	23	
65 Queen Air	2	
95 Travel Air	1	
Callair A-5	2	$18,000
Cessna 150	43	$4,051,000
172, Skyhawk	81	
175, Skylark	6	
180	9	
182, Skylane	53	
185 Skywagon	52	
210	24	
310	16	
Champion 7EC Traveler	2	$119,000
7FC Tri-Traveler	4	
7GCB Challenger	10	
7GCBA	2	
7HC DX'er	1	
Lake LA-4	0	0
Mooney Mark 21	22	$408,000
Piper PA-18-95 Super Cub	1	$2,315,000
PA-18-150 Super Cub	29	
PA-22-108 Colt	109	
PA-23-160 Apache	6	
PA-23-250 Aztec	11	
PA-24-180 Comanche	16	
PA-24-250 Comanche	27	
PA-25-150 Pawnee	24	
PA-25-160 Pawnee	8	
Totals	637	$10,608,000

Note: Shipments January through May, 1961, totaled 2,998 units having a total factory billing value of $56,100,000. In the same period last year the industry shipped 3,775 units with a total factory billing value of $73,799,000. May factory unit shipments were the highest since January and except for March, the highest in billings. Increase largely reflects increased production by Beech and Cessna, particularly the latter, as a result of revising schedules upward because of field reports that a noticeable upward trend in retail sales was evident (AW May 29, p. 69). Cessna schedule increase should also be noticeable in June and July shipments from that factory on the basis of that schedule. Traditionally, however, the industry experiences peak deliveries to its distributors and dealers in May, with shipments tapering off in June and July, while production activity on the following year's models builds up in preparation for their public debuts in the fall. Evident for the first time in factory delivery data is inclusion above of a 160-hp. version of the agricultural Piper Pawnee, in addition to the 150-hp. version.

autopilot as in the case where information for autopilot operation is picked off other gyros.

Precession of the gyro in the guidance unit is virtually nil and the instrument has built into it a precise 2 min. turn. Several of these were tried in the Comanche with the turn coming out within one or two degrees of 360 deg. in all cases.

Brittain recently received a "sizable order" from Beech Aircraft Corp. for the manufacture of Brittain autopilots which will be installed by Beech and bear a Beech trademark on the control head. The system was developed and patented by Alick Clarkson, now vice president of Brittain for research and development.

Soon to be marketed will be a heading select system for the autopilot and a pitch axis unit which will not require gyro inputs for operation, Frudenfeld revealed. Supplemental type certificates for the latter units as well as the two axis unit already on the market have been obtained from the Federal Aviation Agency, Frudenfeld says.

Typical prices of the autopilot range from $795 to $895 for Piper Tripacer and all single engine Cessnas; $1,395 for Beech Debonair thru twin Bonanzas; $1,095 to $1,395 for Apaches thru Aero Commander types.

PRIVATE LINES

National Aeronautical Corp., Fort Washington, Pa., is making deliveries of its Narco UDI-2 Distance Measuring Equipment (DME) for private and business aircraft to regional wholesalers. Units have also been delivered to Federal Aviation Agency for test and evaluation purposes. Each unit has a range of up to 100 naut. mi., weighs 14 lb. and sells for $2,250.

Lycoming's TVO-435 turbo-supercharged helicopter engine, programed to power the Bell 47G-3B helicopter, has been certificated by Federal Aviation Agency. The new engine, which features an AiResearch T-1108 turbocharger, has a takeoff rating of 260 hp. and maintains this rating up to 15,000 ft. with a maximum continuous rating of 220 hp. up to 20,000 ft.

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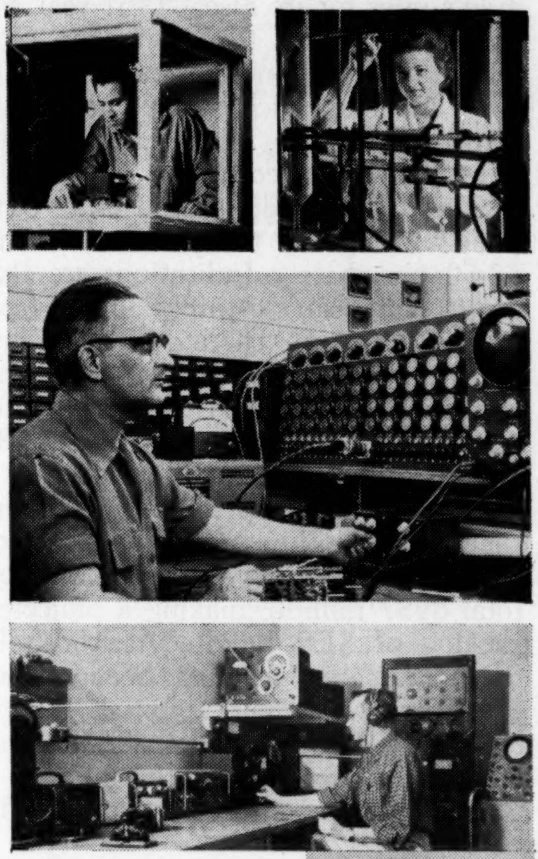

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BARBER-COLMAN COMPANY
Aircraft and Missile Products Division
Dept. T, 1422 Rock St., Rockford, Illinois

North American's 1961 Sales Total May Set Record, Atwood Says

New York—North American Aviation's sales for its Fiscal 1961 year will total $1.2 billion to $1.3 billion, possibly the highest in the company's history, and may reach that volume again during 1962, J. L. Atwood, NAA president, said here recently.

Sales of this order should bring company earnings for the year to $3.30 to $3.50 per share. Indications are that North American's earnings already have reached $2.25 per share during the first three quarters of the present fiscal year and high fourth quarter earnings are expected. The company earned $2.87 per share during all of Fiscal 1960.

Current order backlog totals more than $936 million, the highest since 1957, and proposals under negotiation total $987 million, making a projected backlog of $1.9 billion, Atwood told the New York Society of Security Analysts. Of this total, he noted, 47% is represented by electronic and electromechanical programs.

North American's capital expenditures in 1961 will total an estimated $29 million, with depreciation estimated at $16.5 million. Atwood said capital expenditures should drop somewhat in 1962 and that North American is not planning any equity financing program in the near future.

North American's 1960 total sales of approximately $964 million break down among the company's six operating divisions in this manner:

- **Atomics International Division,** commercial nuclear reactors, sodium reactor and organic moderated reactor experiments and Snap program, $49 million.
- **Autonetics Division,** electronic and electromechanical equipment for Minuteman, Polaris submarines, GAM-77, A3J, F-104 and F-105, $265 million. The Minuteman program currently is the company's largest in terms of total estimated value and constitutes, over the next three years, approximately 49% of Autonetics' business.
- **Columbus Division,** A3J, Redhead/Roadrunner target missile and various antenna systems, $132 million. The A3J attack aircraft program is North American's second largest single program.
- **Los Angeles Division,** B-70, T-39 and X-15 projects, $261 million. The B-70 program, despite recent cutbacks, still is the company's fourth largest program.
- **Rocketdyne Division,** Atlas, Saturn, Thor and F-1 engines, $176 million.
- **Space and Information Systems** Division, GAM-77 and space and weapon systems research, $82 million. The GAM-77 Hound Dog missile program is the company's third largest in total estimated value.

Commenting on the diversification apparent in North American and the entire industry, Atwood said what once could be called the aircraft industry has, in recent years, become something so diversified that it virtually defies description. Further, he said, the industry is in the midst of such fantastic changes that generalities about it are hardly ever valid.

The term aerospace, he said, does not encompass all of the large fields, such as submarines and electronic information systems, in which individual com-

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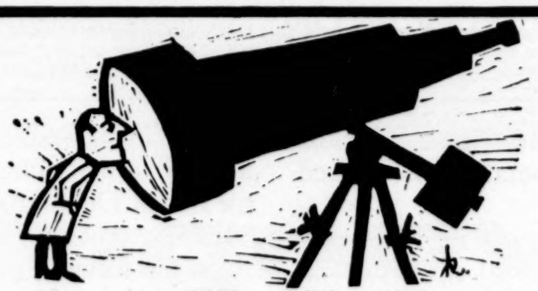
PROBLEMATICAL RECREATIONS 78



Assume the universe is a billion billion light years in diameter and is packed solidly with matter weighing a billion billion tons per cubic inch and each gram of this matter contains a billion billion atoms. Also, every second during the past billion billion years, a billion billion similar universes were created. Without using any symbols and restricting yourself to a total of three digits, write a number that far exceeds the total atoms of all these universes. *—Contributed*

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ANSWER TO LAST WEEK'S PROBLEM: No. From the multiplication table modulo 13 one sees that $X^3 \equiv 0, 1, 5, 8,$ or 12 and $Y^4 \equiv 0, 1, 3,$ or 9. Thus $X^3 + Y^4$ can be congruent to anything except 7 (mod 13). But $19^{19} \equiv 6^{19} \equiv 6^7 \equiv 7$ (mod 13).

LITTON INDUSTRIES, INC.
Beverly Hills, California

panies currently may be involved.

Despite this wide diversification, the companies in the industry are generally referred to as "aircrafts." While most analysts understand this is a term of convenience, Atwood said, the general public still tends to identify the companies with one another in a way he termed "unrealistic."

If one company should experience some difficulty in one of its diverse fields, he said, the result may be stock price fluctuations of other so-called "aircrafts" which may not even be involved in the same activity.

Atwood also noted the increased degree to which scientific prowess has come to supplement industrial might as a measure of national power. Cost-type contracts, covering research, development and testing, as distinguished from production, accounted for approximately 77% of North American's Fiscal 1960 sales and should account for approximately 65% of the company's sales in Fiscal 1961.

Despite diversification, Atwood added, the future of manned aircraft should not be discounted. Renewed emphasis on preparedness for limited warfare has generated requirements for new fighter and V/STOL aircraft.

Rolls Reports 1960 R & D Expenditures

London—Rolls-Royce, Ltd., last year spent $21.6 million on research and development, mostly on aircraft engines. Similar expenditures will remain at a high level this year.

Lord Kindersley, Rolls-Royce board chairman, in referring to research and development costs in his report to stockholders, said "I have every hope that in 1961 we will see a better return" on aircraft engine costs incurred in the past few years.

A considerable amount of these funds has been spent on such engines as the Spey for the BAC 111 medium-range jet transport, and the de Haviland Trident, a more powerful version of the Conway for the Vickers VC. 10 long-range jet transport and also on lightweight vertical lift engines based on the RB. 108 proposed for an STOL version of the Short Belfast freighter.

Rolls-Royce profits of $8.5 million, up $3 million from the previous year, were offset by research and development costs and "exceptional expenses arising from technical troubles with the Tyne engine," which experienced metallurgical problems in the compressor wheel, Lord Kindersley said.

Company sales as of Dec. 31, which include automobiles, diesel engines and industrial transmissions, totaled $305.9 million, up about $32 million from the previous year.

New Offerings

Aeronca Manufacturing Corp., Middletown, Ohio; development and production of defense products, and the design and installation of commercial and industrial environmental control systems. Offering is 160,531 shares of common stock; 136,876 shares to be offered on the basis of 1.55 shares for each share of the capital stock of Flight Refueling, Inc., and an additional 23,655 shares on the basis of 19 shares for each $100 principal amount of Flight's 6% subordinated convertible notes due 1963. Flight Refueling produces a probe and drogue system of aerial refueling.

Polytronic Research, Inc., Rockville, Md. (formerly Acme Tool and Engineering Corp.), engaged in research and development, engineering, production and sale of certain electronic and electromechanical devices and test equipment; products include equipment and components for missiles and aircraft, ordnance equipment, oscilloscopes, etc. Offering is 150,000 common shares for public sale by the company, and 43,750 outstanding common shares by the present holders thereof. The offering of company shares will be made on an all or none basis; public offering price and underwriting terms to be supplied by amendment. Proceeds from the company's sale will be used to expand manufacturing facilities and equip the building with additional necessary shop facilities; to expand sales and engineering force and to finance a research and development program; to pay a $19,000 bank note; to retire $37,000 of 6% convertible debentures due March 31, 1962; to pay $78,000 of balances due on certain other outstanding obligations; the balance to make possible adequate financing of present contracts and to make it possible to negotiate future contracts by a showing of additional financial responsibility.

Stratoflex, Inc., Fort Worth, Tex., engaged in the design, manufacture and sale of hydraulic and pneumatic type hose, hose fittings and hose assemblies, incorporating both the detachable reusable and permanently attached end fittings, self sealing and quick disconnect couplings, mechanical locks, brazed tube assemblies and self locking nuts. The company provides research and development and design engineering; its service and sales are principally to the aircraft and missile industries, and to other industries. Offering is 120,000 shares of common stock for public sales; public offering price and underwriting terms to be supplied by amendment. Proceeds will be used for the retirement of all existing equipment notes and bank indebtedness, and the balance will be added to general funds.

AERODYNAMICISTS

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Attn: Mr. John Hitchcock

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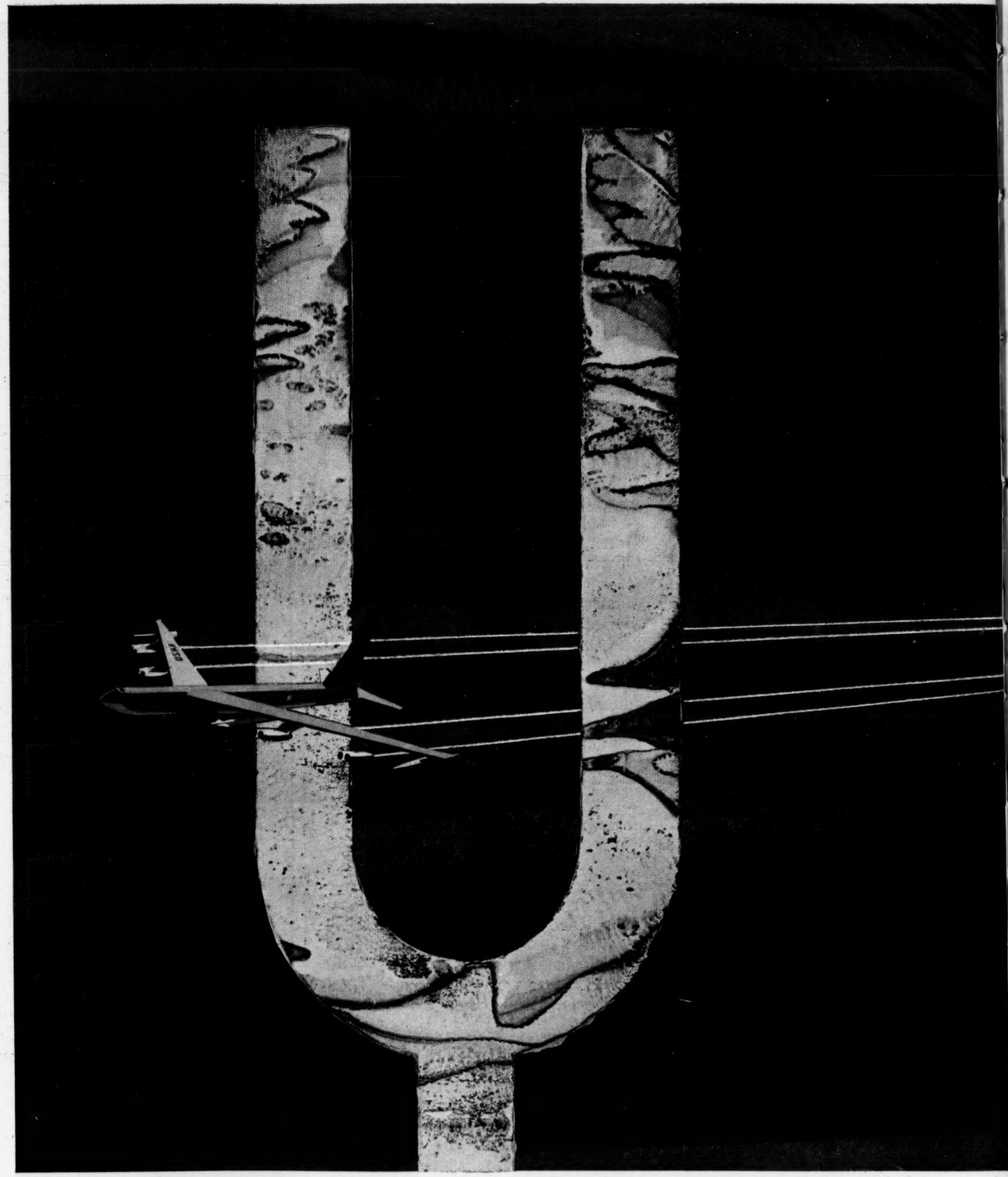
COLUMBUS DIVISION
NORTH AMERICAN AVIATION



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If you would like to help us apply yesterday's principles, like Doppler's, to important projects like B-52 navigation, and if you have a BS, MS or PhD in EE, ME, Physics or Math, please contact Mr. G. F. Raasch, Director of Scientific and Professional Employment, Dept. A, 7929 S. Howell, Milwaukee 1, Wisconsin.

All qualified applicants will be considered without regard to race, creed, color or national origin.

AC SPARK PLUG ❀ THE ELECTRONICS DIVISION OF GENERAL MOTORS

MILWAUKEE • LOS ANGELES • BOSTON

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WHO'S WHERE

(*Continued from page 23*)

Changes

Robert R. Reissig, executive engineer, Vertol Division of The Boeing Co., Morton, Pa.

J. W. Keating, manager, Rocket Manufacturing Division of Aerojet-General Corp.'s Solid Rocket plant, Sacramento, Calif.

Alva M. Hill, manager, Washington, D. C., office of Gilfillan Bros., Inc., succeeding **Roy Field** who has been transferred to the Los Angeles offices.

Roy S. Mushrush, Jr., acting manager of the newly formed Specialty Devices Operation, General Electric Co.'s Defense Systems Department, Syracuse, N. Y.

James N. Sowers, assistant controller, American Airlines, Inc.

Ugo A. Coty, assistant to the Azusa plant vice president, Aerojet-General Corp.

Dr. John N. Dempsey, director, Research Center of Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., succeeding **Dr. Van W. Bearinger**, now general manager of the Semiconductor Division.

Kenneth Ruby, chief mechanical engineer, Motorola's Military Electronics Division Western Center, Scottsdale, Ariz.

R. H. Nelson, electronics manufacturing manager, The Boeing Co.'s Aero-Space Division, Seattle, Wash., and **R. W. Lantz**, acting director of a new electronics packaging group. **Charles Davis** succeeds Mr. Nelson as Bomarc manufacturing manager.

Ivan E. Walenta, chief of the newly created Space Instrument Systems Section, Space Sciences Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif. Also: **Herbert G. Trostle**, assistant section chief of Research Analysis, Space Sciences Division.

Fred C. Mehner, general manager, Houston Fearless Corp.'s Pacific Division, Torrance, Calif.

John K. Records, manager of the newly formed Instrumentation and Guidance Product Section, General Electric Co.'s Defense Systems Department, Syracuse, N. Y.

Keith B. Banks, programs department manager, Space Recovery Systems, Inc., El Segundo, Calif.

John W. Johnson, director of public relations and advertising, Ling-Temco-Vought, Inc., Dallas, Tex., and **Luther S. Smith**, assistant to the board chairman.

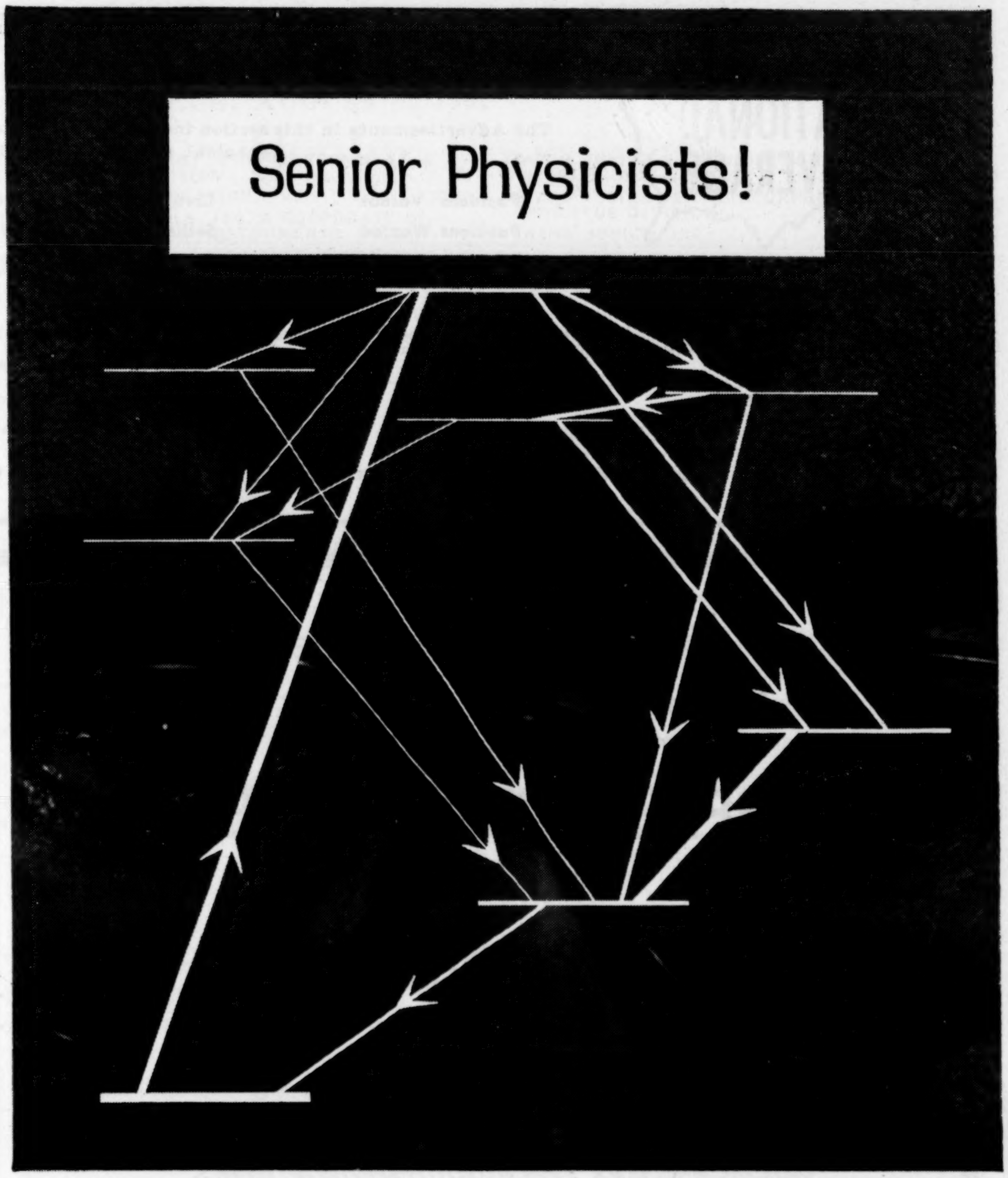
Wallace R. Ruskin general manager, Systems Division, Powertron Ultrasonics Corp., with offices in Huntsville, Ala.

Wilson M. Alford, chief engineer, Ground Support Equipment Department, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., and **Charles B. Brahm**, chief engineer, Electronics Department.

Vincent P. Huggard, manager-Army Affairs, Defense Electronic Products, Radio Corp. of America's Washington, D. C., office.

Carl H. Gottwald, director of engineering, Ryan Electronics, Ryan Aeronautical Co., San Diego, Calif.

Roy E. LeLong, general sales manager, Armstrong Whitworth Aircraft, Ltd., Coventry, England.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BASIC STUDIES of radiation damage in crystals such as "F" centers.

BASIC STUDIES of pumping by means of optical or microwave stimulation; coherence and polarization of emitted energy from a resonant cavity; optimization of materials either gaseous (Cesium vapor, etc.) or solid state; rates of emission and duration of excited states.

Because of the advanced nature of these investigations, they should appeal to mature, experienced scientists at the doctoral or equivalent level. Such men will not be limited by rigid boundaries. They will be given freedom to choose and pursue their own lines of research providing this research is within the scope of corporate interest.

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AVIATION WEEK, AUGUST 7, 1961

A.C. ELECTRONICS DIVISION, GENERAL MOTORS CORPORATION 104
AEROJET-GENERAL CORPORATION .... 2nd Cover
AEROSPACE CORPORATION 3
AIRWORK CORPORATION 102
AMP INCORPORATED 84
ANCHOR COUPLING COMPANY, INC. 89
AVCO CORPORATION .... 4th Cover
AVIATION WEEK AND SPACE TECHNOLOGY .. 96-97

BARBER-COLMAN COMPANY, AIRCRAFT AND MISSILE PRODUCTS DIVISION 101
BENDIX PACIFIC DIVISION, THE BENDIX CORPORATION 74
BENDIX PIONEER CENTRAL DIVISION, THE BENDIX CORPORATION 5
BENDIX PRODUCTS DIVISION, THE BENDIX CORPORATION 66
BENDIX SCINTILLA DIVISION, THE BENDIX CORPORATION 18
BETHLEHEM STEEL COMPANY 16

CHANCE VOUGHT CORPORATION 6
CHANDLER EVANS CORPORATION 13
CLEVELAND TECHNICAL CENTER, INC. 12
CLIFTON PRECISION PRODUCTS COMPANY, INC. .... 3rd Cover
COLUMBUS, A DIVISION OF NORTH AMERICAN AVIATION, INC. 94-95, 103

DEL MAR ENGINEERING LABORATORIES 80
DELCO RADIO DIVISION, GENERAL MOTORS CORPORATION 11
DORSETT ELECTRONICS, INC. 93

THOMAS A. EDISON INDUSTRIES, McGRAW-EDISON 4
EITEL-McCULLOUGH, INC., KLYSTRON DIVISION 54-55

GENERAL ATOMIC DIVISION, GENERAL DYNAMICS 88
GENERAL ELECTRIC COMPANY, FLIGHT PROPULSION DIVISION 90-91
GENERAL ELECTRIC COMPANY, MISSILE & SPACE VEHICLE DEPARTMENT 64-65
GENERAL MATERIALS COMPANY 8
GIANNINI CONTROLS CORPORATION, ASTRO-MECHANICS RESEARCH DIVISION 89
THE B. F. GOODRICH COMPANY, AVIATION PRODUCTS DIVISION 67

HAWS DRINKING FAUCET COMPANY 92
HI-SHEAR CORPORATION 9
HUGHES AIRCRAFT COMPANY 62

INTERNATIONAL BUSINESS MACHINES CORPORATION, DATA PROCESSING DIVISION ... 48-49
INTERNATIONAL TELEPHONE & TELEGRAPH COMPANY, FEDERAL DIVISION 14-15

JANITROL AIRCRAFT DIVISION, MIDLAND-ROSS CORPORATION 10

LIBRASCOPE DIVISION, GENERAL PRECISION, INC. 24
LITTON INDUSTRIES INC. 102
LOCKHEED AIRCRAFT CORPORATION, GEORGIA DIVISION 113
LOCKHEED AIRCRAFT CORPORATION, MISSILE & SPACE DIVISION 20

MAGNAVOX COMPANY, THE—GOVERNMENT & INDUSTRIAL DIVISION 100
MARQUARDT CORPORATION, THE 78-79
METALS & CONTROLS, INC. A CORPORATE DIVISION OF TEXAS INSTRUMENTS INCORPORATED 77
MOTOROLA, INC., MILITARY ELECTRONICS DIVISION 51

NORDEN DIVISION, UNITED AIRCRAFT CORPORATION 68

PRATT & WHITNEY AIRCRAFT DIVISION, UNITED AIRCRAFT CORPORATION 42

R.C.A. DEFENSE ELECTRONIC PRODUCTS 7
R.C.A. INDUSTRIAL ELECTRONIC PRODUCTS ... 87
RAYTHEON COMPANY, ELECTRONIC SERVICES DIVISION 44
RESEARCH LABORATORIES DIVISION, UNITED AIRCRAFT CORPORATION 105
ROCKET POWER INC. 57
ROLLS-ROYCE AERO, LTD. 46

SKF INDUSTRIES, INC., REED INSTRUMENT BEARING COMPANY DIVISION 76
SPERRY ELECTRONIC TUBE DIVISION OF THE SPERRY RAND CORPORATION 70-71
SYSTEM DEVELOPMENT CORPORATION 83

TAPCO, DIVISION OF THOMPSON RAMO WOOLDRIDGE, INC. 98
TEXAS INSTRUMENTS INCORPORATED, APPARATUS DIVISION 22
TRANS SONICS, INC. 17

VITRO ELECTRONICS, A DIVISION OF VITRO CORPORATION OF AMERICA 63

WESTINGHOUSE ELECTRIC CORPORATION, DEFENSE PRODUCTS GROUP 58-59

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 106-111
EQUIPMENT
(Used or Surplus New)
For Sale 112

ADVERTISERS INDEX

Aerojet-General Corp. 108
Berry Associates Inc. 110
Boreas Corporation 112
Burnham Van Service Inc. 112
Cornell Aeronautical Laboratory 108
Gyrodyne Corp. 111
National Aero Leasing Co., Inc. 112
Pratt & Whitney 109
Sikorsky Aircraft 110
Solar Aircraft Co. 106
Trans Caribbean Airlines 112
Van Cleve, G. W. 112
Vertol-Boeing 107

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LETTERS

Gap by Another Name

Thanks to Russia we can now forget about the missile gap and look forward to the forthcoming discussions on whether there is an airplane gap.

Seriously, where is American leadership, or do we continue to play "follow the Russian leader?"

MURRAY OGMAN
San Diego, Calif.

Never Make Mistakes

In his letter in the July 17 issue of AVIATION WEEK (p. 146), M. G. Bishop expresses the need for clearer, more accurate communications. I agree, and I suggest he begin at home.

Example: ". . . everyone is not a writer." Come now, Mr. Bishop, do you really mean to imply that there is no one who is a writer?

Example: ". . . one of our most critical problems is not getting more scientists, . . ." How's that again? Do you mean that not getting more scientists is one of our critical problems, or do you mean that getting more scientists is not one of our critical problems?

We do indeed need more accurate communications. The first step in accurate communications, especially in a technical field, is to make sure one says what he means and means exactly what he says. If the "experts" in the field of technical writing produce ambiguities in every other paragraph, how can anyone expect us poor illiterate engineers to do better?

PAUL F. BARRITT
Collins Radio Co.
Cedar Rapids, Iowa

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

ATL-98 Carvair

I would draw your attention to an error in the caption to the photograph of the ATL-98 Carvair, which appears on p. 127 of your issue of AVIATION WEEK of July 17. In it you said "Tradair said drag penalty of new nose is 12 mph."

My company is in no way connected with Aviation Traders, Ltd., other than that we do business together, and of course we are neither empowered nor qualified to make official comments of the performance or otherwise of any of their products, and we have never done so.

In case you are not aware of the fact, British United Airways, Ltd., is the parent company of Aviation Traders Engineering, Ltd.

L. N. MONNICKENDAM
Joint Managing Director
Tradair, Ltd.
London, England

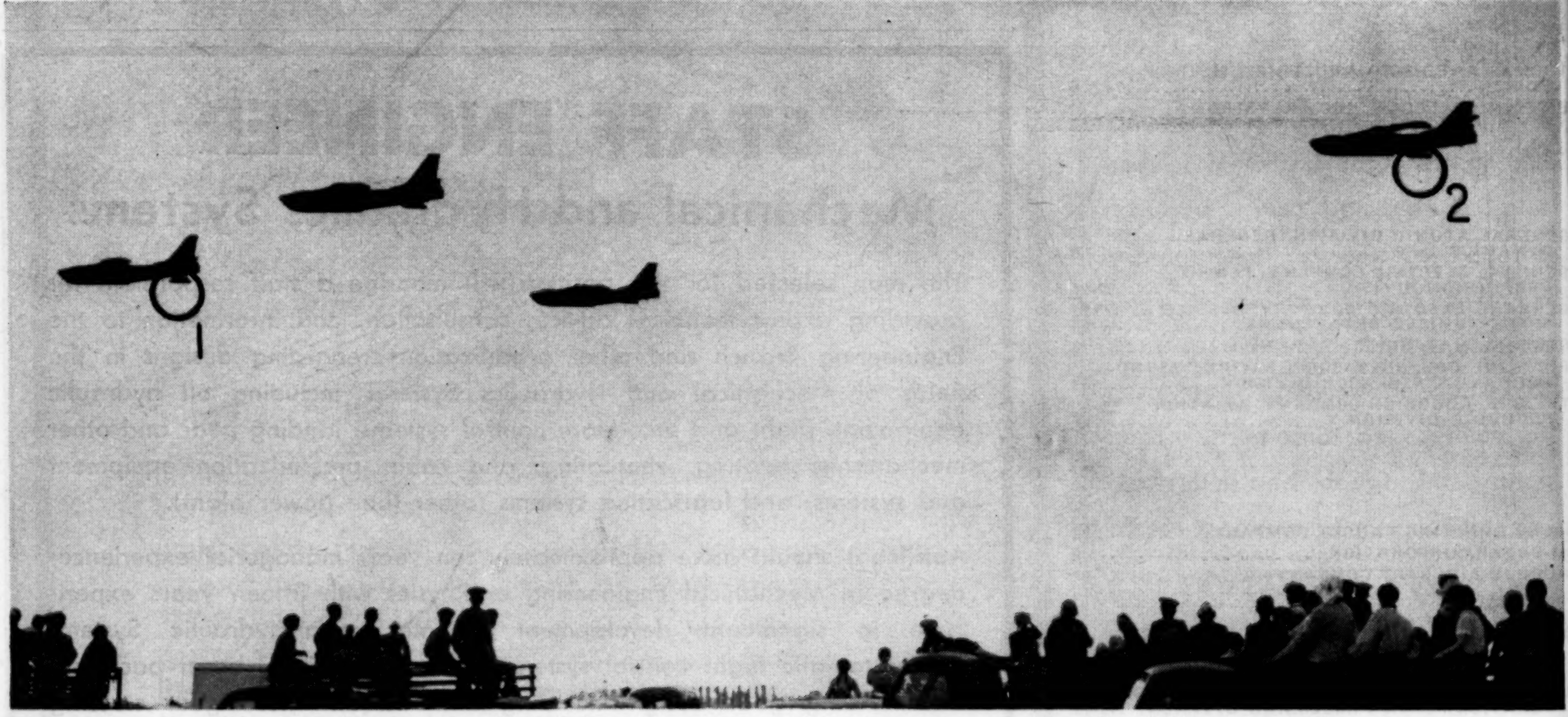
Simulator Photo

I found the article, "JPL Simulator Will Test Mariner A," in the July 17 issue (p. 111) of AVIATION WEEK very informative except for one detail.

The picture of the space simulator chamber being installed in JPL's space facility at Pasadena, Calif., closely resembles a similar unit presently being installed at Lockheed Missile and Space Division facility at Sunnyvale, Calif. Could they possibly be identical units?

THOMAS M. APPLEBY
Specification Engineer Sr.
Lockheed Missile and
Space Division
Sunnyvale, Calif.

(A picture of the unit being installed at Lockheed's Sunnyvale facility inadvertently was placed with the story about JPL's Pasadena Laboratory, as observant reader Appleby has noted.—Ed.)



COMPLETE photo of one run in Aviation Week July 24 (p. 30, middle) illustrates a reader's observation below.

Soviet Seaplane

In AVIATION WEEK, July 24, p. 30 (Beriev Be-8 caption), you indicate that "Extension from fuselage under the tail (below) may be retractable magnetic airborne detection gear or possibly a door for mine laying or ejection of other stores."

Based on the apparent angle from which the picture was taken, however, I believe the referenced objects are actually the starboard wingtip floats. Note that the referenced photograph seems to have been taken from a position bearing about eight o'clock from the lead aircraft (see above), while the picture of the same aircraft at the top of page 30 seems to have been taken from a position bearing about ten o'clock from the lead aircraft. Comparison of the relative wingtip float locations in these pictures seems to indicate clearly that there is nothing unusual about the "extension."

T. H. RIDER
Bedford, Mass.

(Mr. Rider raises a valid point. The object (circled 2) on the last airplane, cropped out of the earlier picture, obviously is the starboard wingtip float. However, one confusing factor is the shape of the object (circled 1), which does not match the shape of the wingtip float. Yet a check disclosed no pinhole in the negative to explain the difference. Changing position of the object relative to the fuselage of the different aircraft supports Mr. Rider's observation otherwise.—Ed.)